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MISSOURI BOTANICAL GARDEN BULLETIN

Volume 57

1969

MISSOURI BOTANICAL
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MISSOURI BOTANICAL GARDEN

BULLETIN

VOLUME LVII NUMBER 1

JANUARY-FEBRUARY 1969

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MISSOURI BOTANICAL GARDEN BULLETIN

VOLUME LVII NUMBER 1 JANUARY-FEBRUARY 1969

FOREWORD

THE INERTIA gripping this institution for the last 30 years has been overcome. We have taken positive steps to fulfill our proper role in this community and in the scientific world.

Staff at the Garden has increased 50% since 1965. Only 40% of the total staff have been here longer than 3 years. We feel that these new faces mean fresh ideas and enthusiasm. At the same time the veteran staff, experienced and knowledgeable, provides the necessary stability for a growing institution.

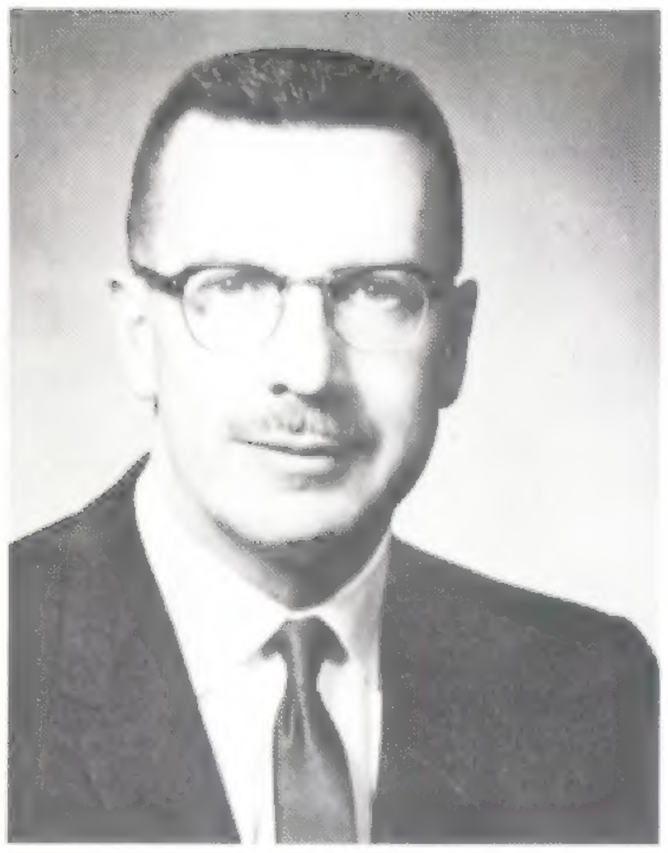
The horticultural operations were in relatively good condition in 1965; therefore, research and teaching at the Garden have received the greatest initial emphasis. Our scientific staff has quadrupled; the number of graduate students from Washington University and St. Louis University has increased more than tenfold. As a result we have been able to attract new grants for our research and teaching activities. The total research and research related expenditures and income at the Garden for 1968, including grant and contract funds, was over $300,000.

Our income and expenses have increased about 60% since 1965 and we have balanced the budget each year.

We believe that this report on the activities of the Missouri Botanical Garden for the year 1968 illustrates movement in the proper direction.

Mark Paddock

COVER: *Design by Peter Geist*
Illustration from a woodcut of *Solarum* or *Nachtschade* (common name, black night shade) in the *Latin Herbarium* printed by Peter Schöffer in Mainz in 1484.



From the Director

TODAY, SCIENTISTS and citizens of the world look to the Missouri Botanical Garden for leadership in botany, ecology, natural history, and environmental studies. The Ford Foundation recognized the potential and significant role the Garden staff could play in the world crisis with the environment by granting $420,000 to train biophysical ecologists. We are considered the world center for studies of this kind.

I was asked to testify last year for the Sub-Committee on Science and Astronautics of the U.S. House of Representatives on ecology, and again this year for a joint colloquium of the Senate and the House on the quality of the environment. The U.S. Senate and House formed an ad hoc congressional committee prepared to act on the urgent problems of environmental quality. This committee selected a group of advisors from throughout the U.S. I was delighted to be asked to serve as chairman of this advisory group, and have agreed to accept the challenge. In addition, I advise and counsel the Public Health Service on the condition of the atmosphere and its effect on life. The National Science Foundation has asked me to consult with them on matters of policy concerning the support of biological and medical sciences.

My contribution to these national forces is a synthesis of the total experience of the Garden itself—past and present. I cite these examples to emphasize that our diverse activities constitute an amalgam whose weight has solid impact in national and international arenas of scientific decision making.

Our Garden staff has accepted roles of leadership in the largest floristic project ever undertaken in this country—the cataloging of the Flora of North America. We participate fully in the International Biological Program. In 1967, when the crisis over Aldabra Island, located in the Indian Ocean, arose, we were asked to advise and to participate in the discussions between the National Academy of Sciences and The Royal Society of Great Britain. We believe our influence went a long way in preserving the rare flora and fauna of this natural ecological laboratory.

The Missouri Botanical Garden is in the limelight. Our staff, the students in residence, the post doctoral fellows and visiting scholars are drawn to this institution by the assets of a large herbarium, a remarkable library, and a tradition of outstanding leadership. The students we train will be some of the future leaders in American science.

Our capital fund drive for $3,000,000 must be successful to secure the future of the Garden—to assure that space, staff, and support will continue.

David M. Gates

From the Trustees

WHEN HENRY SHAW founded the Missouri Botanical Garden, and then later in his Will left the running of his garden to a Board of Trustees, he was very specific as to how the Garden was to be run and what was to be done with the assets of his estate. Mr. Shaw made it very clear that the Garden was to be forever available to the public as a display institution and that the staff was to carry on scientific research and teaching.

Unfortunately, although the estate of Henry Shaw helped support this institution for many years, inflation has troubled the Garden, as it has all similar institutions. Foresighted as Mr. Shaw was, he could not possibly have envisioned the operating cost of the Garden today.

To keep this institution operating, it has been necessary to reach beyond the residue of Shaw's Will and raise additional funds through the Arts and Education Council, Friends of the Garden, operations, and the generosity of interested companies and individuals. With this additional income, the Board has been able to maintain what we have and increase our research and teaching staff. However, it is impossible to generate enough funds to build the capital improvements that are needed—primarily, a new library-herbarium building and an educational building.

The Board has been working for the past year toward the first community-wide capital fund drive ever to be conducted by the Garden. This drive starts January 1, 1969 and the goal is $3,000,000 for capital improvements and increased endowment. There is no question in the minds of the Board of Trustees that this amount can be raised. We cannot wait to build these new buildings.

We of the Board ask for your help in raising this money during the first half of 1969. We not only need your financial help but also your strength as another worker.

Harry E. Wuertenbaecher, Jr.
President

ANNUAL REPORT—1968

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Our many thanks to Claude Johnston, Ken Peck, and others for the photos in this issue.

EDUCATION

Kenneth O. Peck

A NEW PART of a botanical garden's *tour de force* is an active education department which has the undergirding of research and imaginative display programs. It has become a responsibility of the botanical garden to disseminate the kind of knowledge about plant life that gives satisfaction as well as an understanding of the problem of keeping our environment liveable. It is a recognized fact that an association with living plants, however passive, is not just a happy pastime but a necessity.

The process of teaching at the Missouri Botanical Garden is work. Much of this teaching is directed to young people. If we teach children how to read words and manipulate numbers in school, why not teach them to understand the plants they live with? Adults must learn, too, but many of them, unfortunately, do not have the time or interest to pursue active studies in natural history.

In 1968, the programs of the Garden Education Department

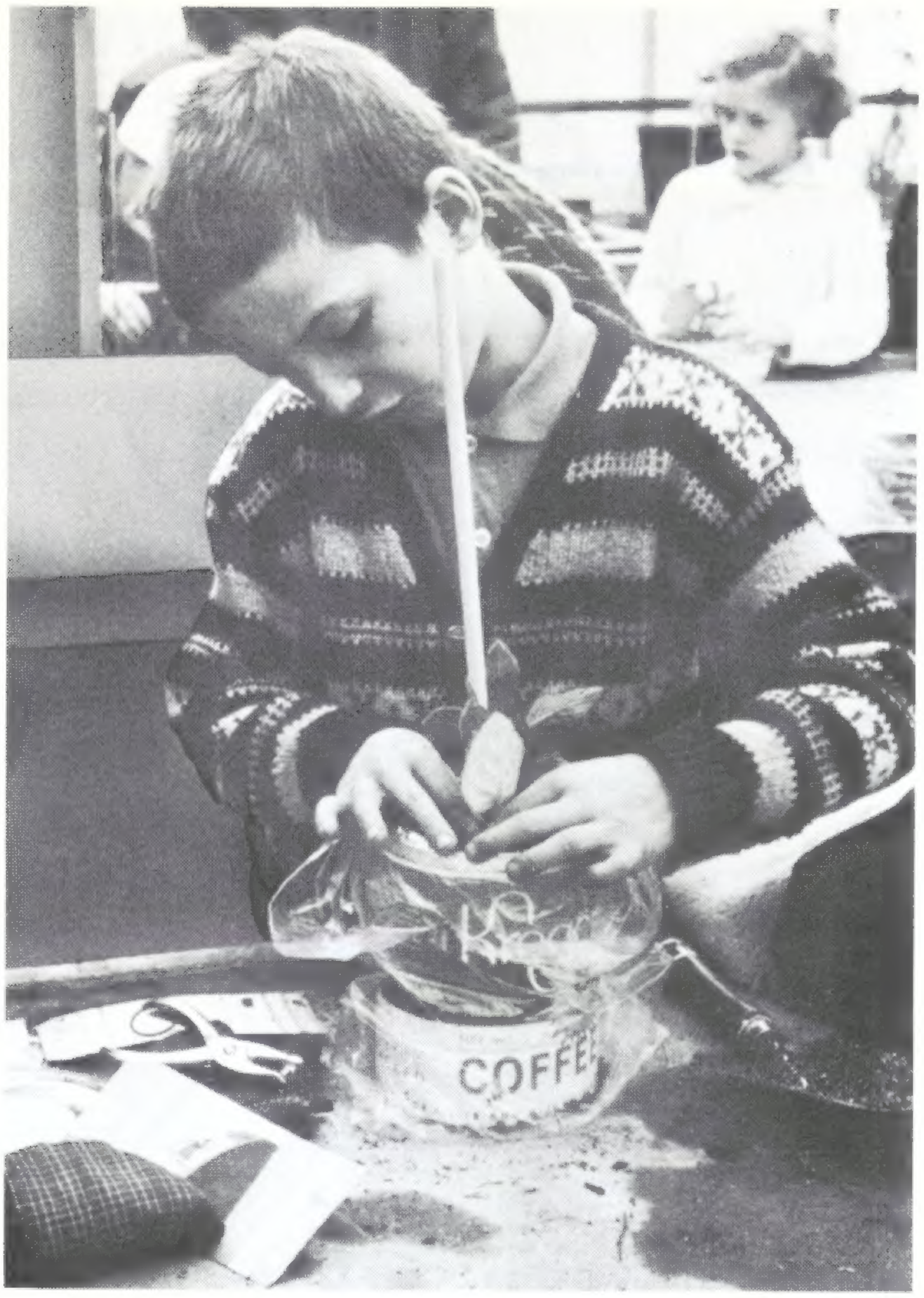
fared very well. The Saturday classes continue to be popular. We have an average attendance of 75 children for each of the 39 meetings. Christmas wreath-making and classes involving the use of live plant materials like bulbs, seedlings, cuttings, and terrarium plants draw as many as 100 to 350 youngsters. We are pleased to be able to handle crowds like this in spite of the inadequate facilities. The Saturday programs entered their eleventh year in December, 1968.

Another program which is getting to be an "old-timer" is the Pitzman Summer Nature Program for children. This is one of the outstanding programs of public service to young people in St. Louis. There are no other programs that have received such faithful support over the years as that provided by the Pitzman Charitable Trust. Because of this support, it has been possible to offer the programs free of charge to all children. Another valuable asset are the classes offered by the St. Louis Audubon Society administered by Earl Hath. During the last 8 years, the classes have been taught primarily by Mrs. Cecil Crizer, Miss Sarah Owen, and Mrs. Robert Higgins. Over a ten-week period this past summer, 560 children made nearly 4,000 visits to complete their courses in nature study. Eighty-five percent of them received certificates.

Two other facets of educational activities that complement our overall program are Garden tours and plant science lessons for school children. Tours have been given for many years to all age groups. In 1968, 3500 youngsters were given tours in the Garden. In May alone, 1755 children were given guided tours! Another 3900 children came to the Garden for lessons in botany and plant identification. The average group size for these classes has been 50 to 55 children, but some have been as large as 180. Lack of space has prevented us from scheduling additional classes because all of the plant science lectures are given indoors. Some groups have had to miss these opportunities.

The most recent program of the Education Department is the Guide Training Course, taken by 25 volunteer women. They received instruction from every department head in the Garden, and were given a comprehensive written examination. They are now conducting tour groups of children and adults through the Garden.

The Arts and Education Council of St. Louis granted money to the Missouri Botanical Garden Education Department for the purpose of working with "inner city" young people. Through the office of the Elementary Sceince Supervisor of St. Louis City Public Schools and the Principal of Jefferson School, 40 fourth and fifth grade chil-



dren will have twenty lessons in botany and horticulture by early spring, 1969. One third of these meetings have been held. It has been a rewarding and enriching experience for the Garden staff members and the children.

In considering our plans for the future, our most ambitious project would be the construction of a new education building with an auditorium, large classrooms, and attached greenhouses and work areas. It is very exasperating to schedule classes under existing conditions when more than one group needs the same location at the same time. It is equally frustrating not to have adequate shelter from the rain or extreme heat for the children in the outdoor summer classes.

Another plan to broaden the Garden's educational out-reach program is the Plantmobile, an idea proposed by our Director, based on the Bookmobile concept. Such a medium, properly staffed, would give us a good opportunity to take plants and the knowledge of them to the people. One of the serious problems in getting groups to visit the Garden is transportation. Some schools never get the opportunity to visit the Garden at all. The Plantmobile would alleviate this problem to a large extent.

Community neighborhood outdoor vegetable gardens would provide recreation as well as a sense of accomplishment. Although this is not a new idea, our staff has some interesting ideas for implementing the community vegetable garden concept.

New courses for adults are also envisioned. Some of the problems in arranging additional adult courses are adequate staffing and the scheduling of meetings in places with limited facilities. With the present staff and facilities, no more than two adult courses can be scheduled at a given time.

A course on home landscaping is one that we are planning for next year, 1970, in addition to one on the materials for gardening. This latter course would cover the use of sprays, fertilizers, herbicides as well as the comprehensive use of certain garden implements.

It is our sincere hope that conditions will develop to make possible the expansion of our exciting programs.

THE LIBRARY

Eugenia Maddox

ALTHOUGH MUCH of the early history of the development of the Library has been lost, the annual reports of the Director, beginning with the first published report for the year 1889, refer briefly to Library activities, as well as to the earlier history of the Library.

There was always a struggle to find the necessary financial support for the Library. In spite of this obstacle, however, the book, periodical, and reprint collections continued to grow at a fast pace, largely through gifts and exchange of publications with other institutions.

Some of the milestones in the history of the Library help to make understandable the exceptional quality of the collection. In 1858, after Henry Shaw had decided that the Missouri Botanical Garden should be a research institution as well as a public garden, he commissioned Dr. George Engelmann to purchase botanical books and journals in Europe. Dr. Engelmann, a St. Louis physician-scientist, was recognized as one of the foremost botanists in the United States at that time, and was therefore well qualified for this assignment.

After Dr. Engelmann's death in 1884, his personal library to-

gether with his manuscripts and drawings came to the Missouri Botanical Garden. The Library was further enriched in 1898 when Dr. Engelmann's son gave the Garden a large collection of letters his father had received from the leading botanists of the world.

"The gift of Dr. E. Lewis Sturtevant to the Missouri Botanical Garden of his extensive and valuable library of Pre-Linnaean works was an event in the history of this institution. This collection had been secured only through years of searching and at great expense."[1] The Sturtevant Library of almost 500 rare and important titles was received in 1892.

Finally, Dr. William Trelease's contribution to the library should be mentioned. When Dr. Trelease became the director of the Missouri Botanical Garden following the death of Henry Shaw in 1889, he immediately began the publication of an *Annual Report*. This publication was exchanged regularly for the publications of other botanical institutions throughout the world. Many of these exchanges continue to the present day.

Currently the Library totals approximately 65,000 books and some 100,000 catalogued separates. In addition, it has significant holdings of microfilm, microfiche, microcards, manuscripts and maps. The Library's primary function is to serve the Garden staff and students of local universities, but because of its international recognition, scholars from throughout the world visit the Library to do research. Many others, who cannot travel to the Library, send written requests for information or interlibrary loans.

Library quarters are filled to capacity at present, and only by constant shifting and squeezing is space found for current acquisitions. This crowded condition will be alleviated when a temporary steel prefabricated storage building, now under construction, is completed. The Library will then have additional shelf space for approximately 16,000 volumes.

It may be a few years before a much-needed library addition to the present administration building can be constructed, and the staff is devoting much thought to the planning of future library facilities.

The staff members are two librarians, one full-time and one half-time clerical assistant, and three part-time book repairers. We hope that a cataloguer and an additional clerical assistant will be added soon. We then will be able to catalogue the Library's large backlog of books, as well as to recatalogue and reclassify journals. The change in the classification of journals will greatly facilitate their use.

[1] Missouri Botanical Garden. *Annual Report*, 10th, 1899, p. 71.

The continuing need for book repair and restoration is being met partially with funds generously provided by the National Council of State Garden Clubs and individual gifts.

We hope that it will be possible within a short time to increase the effectiveness of the Library by providing greater opportunities for bibliographical research and publication, and by arranging displays of some of the Library's rare and beautiful books. All of our planning and activities are geared to make it possible for us to be of service to the scientific community.

The 44 page *Guide Book to the Missouri Botanical Garden,* sells for $1.25 at the Main Gate and the Garden Gate Shop. This book is an excellent souvenir of a trip to the Garden.

THE HERBARIUM

Susan Verhoek

THE MISSOURI BOTANICAL GARDEN Herbarium is a collection of the vegetation from all over the world. Collectors gather trees and vines from the tropics, mosses from farther north, and sunflowers from the Missouri roadsides, preserve them by flattening and drying, and finally send them to the Herbarium where they will be named and glued to sheets of heavy paper and then filed in the proper sequence in steel cases. Once properly named and labeled, roadside weed and rare orchid alike become an important record of the existence of that plant in a particular geographical location at a certain time. The plant specimen also becomes a valuable example of the appearance of the plant to which a certain name applies. The plant specimen, the real thing is worth much more than a picture.

Plant collecting and naming has been an on-going process since the beginnings of recorded civilization. In St. Louis, plant collecting was given its impetus about 1851 when Dr. George Engelmann, a St. Louis physician-botanist, persuaded Henry Shaw that his botanical garden would not be complete without a library and herbarium. The nucleus of the new Herbarium was the 60,000 specimens in the

Bernhardi collection bought, under Shaw's direction, by Dr. Engelmann. Engelmann had been sent to Europe for the purpose of purchasing additional material for the Herbarium and Library.

Engelmann's personal herbarium of ultimately 98,000 sheets was added to the collection along with the specimens gathered by the doctor's botanical emissaries on expeditions into the American West.

Since then our Herbarium has accumulated over two million specimens. These specimens come to us in several different ways. During the past year two private herbaria were donated to the Garden: the Julian O. Neill collection of Illinois plants and Elizabeth Venrick's North American collection. Four hundred excellent specimens of plants from Polynesia and Africa were purchased by the Herbarium from collectors in those areas.

Some of the 52,000 sheets accessioned this year were the result of the Missouri Botanical Garden collecting trips to Panama, Mexico and South America during the previous year. Another large number of specimens came to us through exchanges with other botanical institutions. Various North American herbaria and those in Colombia, Argentina, Mexico and England exchange plants of the tropics for our plants from Panama and Mexico. Shipments of plants from Leningrad and Perth came in return for North American plants and copies of the *Annals of the Missouri Botanical Garden*. A great

many of the exchanges were the result of the trade of photographic prints of important African specimens housed in European herbaria for plants from countries whose interest is in the vegetation of Africa. This brought plants to Missouri from Sierra Leone, Republic of South Africa, Rhodesia, Egypt, Kenya, India and Portugal.

As a reflection of the world-wide scope of the Herbarium, 105 requests for loans of specimens were honored and sent to institutions all over this country and to such widespread places abroad as the Netherlands, Brazil, Canada, Czechoslovakia and Israel. In spite of the political upheavals in some of these countries the Herbarium has experienced no problems with its loans or exchanges other than a short delay in getting a shipment of specimens from Egypt.

As a teaching aid and to aid in managing the increasing collections, a program has been initiated in which the students pursuing degrees at the Garden also work part time with the collection. The greater involvement in the Herbarium will broaden their knowledge of plants.

The future of the Herbarium promises to be busy. During the next year we expect to handle approximately 160 incoming and outgoing loans. We can also expect an increased number of exchanges, reflecting our continuing work in Panama and our expanding interest in African material.

With the completion of the Herbarium temporary annex (a prefab building) early in 1969, there will be a major shift in the collections. Some of the specimens, including the ferns and grasses, will be moved into the annex. This will give some badly needed room in the main building both for study areas for the increased number of research and student personnel, and for more herbarium cases to allow the collection to be further enlarged. The expansion will allow the filing of nearly 1500 specimens that could not be fitted into the cases, and also remove some of the danger of damage to the specimens from overcrowding for a few years at least.

The coming year will also see changes in the Cryptogamic Division of the Herbarium. With the arrival of Dr. Marshall Crosby in September, the Garden gained a staff member competent to supervise the lichen, algae, liverwort and moss collections. The current emphasis is on the moss collection. The entire collection is in the process of being re-curated. The old packets in which mosses were kept are being replaced with new ones of high quality paper. Instead of attaching the packets to herbarium paper as was done previously, the packets are being arranged in file cases especially designed for storing cryptogams. The change will make the nearly 25,000 specimens of mosses more accessible for research projects.

HORTICULTURE

Derek Burch

THE GARDEN that Henry Shaw left at his death in 1889 was still primarily a rich man's country estate, but a tradition of displays for the public and a strong research interest was firmly established. In the years that followed, the Garden became more and more a public display area covering not only the material hardy in this area but an impressive selection of tropical plants housed in several large conservatories. The changing interests of the horticultural staff were reflected in the accumulation of collections representing several plant groups, and some remarkable contributions to the horticultural field were made by selection and breeding in these groups. All through this period the research work at the Garden continued and, again reflecting the interest of the staff, various horticultural fields received emphasis and a number of important contributions to knowledge were made.

This background of display, education, plant introduction, testing, and research that we have inherited has shaped the present Garden and the extent of our collections. Our deep concern now is to assess the place of the botanical garden in present-day America and to be certain that we are using our resources effectively to meet the demands of modern society.

The activities of the Garden fall under the three headings—display, education, and research. To a large extent the horticulture department is a service department providing material for the research and education programs; in addition our displays very often have a secondary purpose in these two fields.

Each part of the Garden is being examined to find the best balance for display, research, and educational uses. The Rose Gardens, for example, are primarily for display but serve also as a living catalogue in which people may see how roses actually perform in this area and as a continuing demonstration of cultural practices. The Climatron is one of our major display areas, demonstrates the effect of the different climates in it on plant growth, and is a living class-

room of the rain forest community and economic plants. The various test gardens which are not open to the public give valuable information on the suitability of the plants for the area.

During the last year we implemented the overall plan for the horticultural operation which was developed two years ago. One aspect calls for increased display in certain parts of the Garden. These areas will receive as much attention as possible to keep them in first class condition. This "high maintenance" area will include the Linnaean Garden, the rose gardens, the lily pools and main axis, and the Knolls. The remainder of the grounds will be put into more natural plantings. Work has continued on replanting the Lake surroundings with wild flowers and shrubs. Plans are under way for a conifer section and old rose collection. At the same time the consolidation of the working and service areas has continued. The test gardens will be planted in areas near the nursery, the propagating house, the lath houses, cold frames and standing area. These test gardens will all be within easy reach of the shops, tool storage areas and close to the soil, sand, lime storage, and the leaf, wood chip and compost heaps.

The trees in the Garden have grown during the last several years and many of the crowded and undesirable species have been removed to open up short vistas.

In the greenhouses Mr. Kohl has continued to mount extremely successful shows as well as growing plants for the grounds and for a number of organizations. The generosity of the Herb Society has allowed us to add cooling equipment to the new range of growing houses as well as a removable shading setup that is particularly valuable in spring and fall when the shading compound that we apply to the roof to keep the houses cool in summer has worn thin.

The Floral Display House has had its usual outside public use. Several local horticultural groups used it for their main shows, and the Junior League Ball was again held there.

The Tropical Growing Range is looking better and better. We are gradually sorting through the plants, some of which have been there for many years. We decide in each case whether they should be kept for research or teaching purposes or for future use in our public display areas.

The replanting of the Climatron with the plants most appropriate for the different climates, has made some progress. Most of the material is still in the growing phase and not yet suitable for planting.

The Desert Houses have received some attention in replanting and thinning, but most of the emphasis here has been on growing new material for a major replanting. We must decide, when our financial future is certain, how large a public display we can maintain and if the display area can be increased. We can combine the desert flora from the present two houses in one of the larger growing houses, making the present houses available for displays of different climatic types.

Among the other recent changes has been a streamlining of our operations and increased mechanization. Jim Hampton, who manages the grounds with a very small crew, has added new equipment

to improve efficiency. He has plans to acquire additional grass-cutting equipment. This chore consumes excessive man hours of our labor force during the summer.

All the horticultural operations lean heavily on the Maintenance and Engineering Department headed by Jim Hampton and Jack Pavia. The new boilers are proving extremely successful in operation although much of our steam piping is in a very precarious condition with some houses literally held together by a series of emergency clamps.

The work of systematically rebuilding the greenhouses continued this year with work on the experimental range. This work has to be squeezed in among the many other demands for service that generate from our expanding research activities. This involves not only all the existing buildings but new trailers and temporary structures pressed into use to ease critical overcrowding in our collections and laboratories.

One timely bonus during the year has been a complete kitchen installed, with money provided by the St. Louis Herb Society, in the Museum Building. The kitchen has already proved its value.

There has been a great deal of deliberation on the present operations and our aims for the immediate and long-term future. Many of the Garden's jobs have been streamlined, and a changing emphasis in our activities will allow more economies in this direction in the future. There will probably never be enough staff to tackle all that we would like to tackle, just as there is never enough greenhouse space to let us grow everything that we would like to grow. Our best hope is to judge as dispassionately as possible which of our operations are worthwhile, and by providing these services, demonstrate to the community that the institution is one worthy of its continuing and increased support.

The staff of the Horticulture Department is involved in a two-year horticultural education program at Meramec Junior College and with the course work offered by the Botany Department of Washington University. These associations will continue. We are developing closer ties with the St. Louis Board of Education for similar projects at the high school level.

Globe Democrat Photo

Friends of the Garden

Mrs. Charles Ruprecht

"HENRY SHAW left a legacy rich in knowledge and pleasure; yet while the Garden may grow beautifully, its purpose will not be fulfilled if the people of St. Louis do not become involved with it." Mrs. William Bascom, President of the Friends in 1961, expressed these sentiments in a *Bulletin* article, and her words are equally applicable today.

The Friends of the Garden were organized in 1939, the first "Friends" organization in St. Louis . Mr. Dudley French guided the program from its inception, with a view to augmenting the income of Henry Shaw's endowment fund. Maintenance costs, the eternal problem, were consuming the available trust funds. Dr. George Moore, the Garden's Director, wrote to the local garden clubs and the commercial suppliers of the Garden for minor contributions. Mrs. Hazel Knapp organized a group of 150 women to address 17,000 envelopes for the first public appeal. This produced 600 new members for the Friends and an additional $1,000 for the treasury.

By 1959 the Friends had 2500 members and were contributing $25,000 to the Garden's annual support. At this time, the group was reorganized, with officers and an office. Mr. John R. Averill was the first president. Volunteers worked at the gatehouse, the present Garden Gate shop, handling the mailings and the files.

With the dedication of the Climatron in 1960, the Garden achieved nation-wide recognition architecturally and botanically, resulting in increases in attendance by the public as well as new members for the Friends. By the end of 1968, the Friends numbered 2950 and were contributing $54,000 to the Garden.

As the Friends have grown, so have the benefits of being a Friend. Attendance at Previews alone indicates the growth of interest in the Garden within the community. The new guide course, under Kenneth Peck's direction, is an opportunity for a horticultural and botanical education. The *Bulletin's* column on "Gardening in St. Louis" is the only available publication applying specifically to our difficult climatic conditions. Above all, the 70 acres of the Garden and the 1600 acres at Gray Summit are available as retreats from the noise and confusion of contemporary living. Dr. David Gates has managed to manicure Mr. Shaw's "country place" with about one fourth of the help available to Mr. Shaw.

Looking toward the future, the role of the Friends becomes increasingly important as a supporting organization enabling the Garden to continue research and education. Some of the pioneer work on aureomycin was done by Dr. Benjamin Duggar at the Garden. Dr. Edgar Anderson's hybridization of corn may increase the world's food supply in the future. The use of the Herbarium and the Museum by students could open new fields of knowledge about the past and the coming world. Your membership in the Friends gives you a small but essential part in such projects.

Be a Friend and Bring a Friend

In 1968 the Garden Gate Shop again contributed substantially to the Garden's income. The shop is managed by Mrs. Edwin F. Stuessie and staffed by trained volunteers from the Friends of the Garden. The good taste and appeal of the merchandise in the shop is attested by the year round volume of business.

Asphodeles Luteus

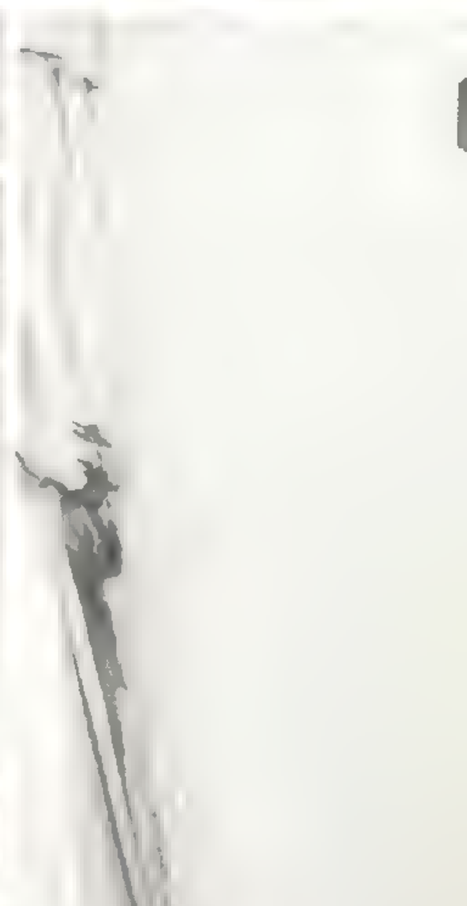
Asphodele Jaune

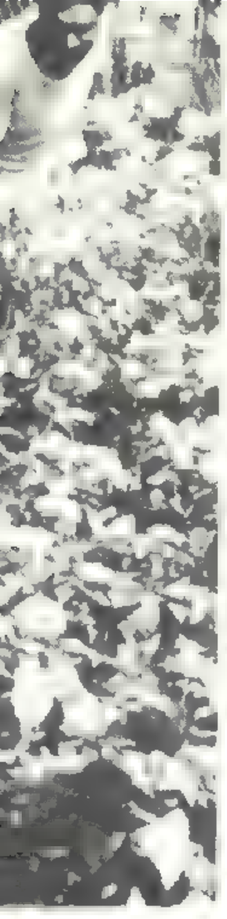
CEREUS *grandis foliorum ramosus flore alto fragrante calyce aureo tecto*

Reproductions, 21½ inches by 14¾ inches, of the color plates shown here are available to members of the Friends of the Garden.

These exact reproductions are an exclusive offering of the Friends membership committee. The pictures are from rare books in the Missouri Botanical Garden library: *Les Liliacées* (1802-1808) by Pierre-Joseph Redouté, the great French botanical artist (current price of the volumes estimated at $60,000); and *Plante selectae* (1750), written by Christoph Jakob Trew, the German physician and botanist, and engraved by Georg Ehret.

In addition the Friends are offering a choice of living plants mimosa pudica (sensitive plant), angelwing begonia, or the plant of the season.





Methonica Superba — *Methonique Superbe*

Lilium Superbum — *Lys* — *Pompon*

Here is how to get either a plant or a reproduction.

- Become a member of the Friends of the Garden
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It is possible to get *all four* reproductions *and* the living plants — call or write the Friends' office at the Missouri Botanical Garden for details.

Telephone TO 5-0440

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SYSTEMATICS

Walter H. Lewis

RESEARCH BY STAFF and graduate students centered around activities in the Herbarium and Library as well as the Departments of Botany at Washington University and St. Louis University. No fewer than 14 projects are being investigated and range from floristic studies in Panama, under sponsorship of the National Science Foundation and U.S. Air Force Office of Scientific Research, to a detailed analysis of abnormal chromosomal behavior in plant cells that for some unknown reason appear like carcinomas of animals infected by cancer. The latter is supported by Public Health funds through the Center for the Biology of Natural Systems at Washington University.

Diversity, then, marks one of the great attributes of research conducted in systematic botany at the Garden. All major areas are represented, namely floristic studies, revisionary research, and experimental taxonomic endeavors. These accomplishments require a degree of prowess not matched at many other institutions in the world, and we would therefore like to outline briefly our progress in the past year.

FLORISTIC STUDIES: The arrival of our new Curator of the Flora of Panama (Dr. Duncan M. Porter) guarantees the continued progress of this large project. It involves publication of all plants known to occur in Panama. To do this, of course, requires the collection of plants in even the most remote parts of the country, the determination of thousands of specimens sent back to the Garden, and the distribution of material to interested botanists throughout the world. These specimens make possible the writing of the Flora of Panama, and various staff members assume responsibility for treatment of specific groups. The largest share, however, falls to Dr. John D. Dwyer of St. Louis University, Dr. Joan W. Nowicke, Dr. Thomas B. Croat (who is also involved with the publication of a manual for part of the Canal Zone), and the Curator, Dr. Porter. Thousands of pages of the Flora, all well-illustrated, have been published, but much more effort is required for completion of what will be one of the most comprehensive treatments for the tropics of the New World.

Dr. Porter is also writing parts of the Flora of the Galapagos Islands, and Dr. Viktor Muehlenbach continues his treatment of weedy species introduced into the Missouri flora.

REVISIONARY RESEARCH: As exploration and finding of new plants proceeds and our methods of classifying them improves, there is a constant need to update and synthesize our knowledge of plant groups. It is important for botanists, foresters, agriculturists, and others to know, for example, the correct name for any plant; its characteristics; to what it is related; where it might be found; with what it might hybridize; under what conditions it might be expected to grow, as well as several other equally significant questions which arise about most plants. Revisionary research attempts to answer these and other questions and so the natural scientist, whether interested in pure or applied aspects, is quite dependent on systematic botanists completing such works. We can cite the following recent examples: (1) a world-wide revision of the *Phytolaccaceae* (poke weeds) by Dr. Joan W. Nowicke, (2) a revision of the tropical American moss genus *Pilotrichum* by Dr. Marshall R. Crosby (largely through Duke University), (3) and revisions of Panamanian species (both in the coffee family) of *Rondeletia* by Mr. Joseph H. Kirkbride, Jr., and of *Psychotria* by Miss Olga Herrera (now Mrs. Bruce MacBryde). Research of the same nature continues for many other groups, notably for *Chamaesyce* (Dr. Derek Burch), *Galphimia* (Mr. Bruce MacBryde), *Zygophyllaceae* (Dr. Duncan M. Porter), *Claytonia*, the spring beauty, and *Hedyotis*, the bluet, (Dr. Walter

H. Lewis), *Sisyrinchium*, the blue-eyed grass (Mr. Royce L. Oliver), *Hamelia* (Mr. Thomas S. Elias), *Jacquemontia* (Mr. Kenneth R. Robertson), and *Maripa* (Mr. Daniel F. Austin).

EXPERIMENTAL TAXONOMY: Such studies usually involve research not readily initiated from herbarium material, or at least requiring microscopic examination of living plants. We study cells and chromosomes (Dr. Lewis, Mr. Oliver, Mr. Terry Luikart), cell metabolism (Dr. Sally Walker), pollen morphology (Dr. Verne Durkee who is visiting from Grinnell College), seed morphology (Sister Victoria Hayden, Ph. D.), and leaf anatomy (Dr. Burch). With these data in relation to observable features of the plants, a much greater understanding of evolution, for example, is possible, and more satisfactory answers to the problems noted above are also likely.

Inseparable from systematic research is our activity in systematic training. Courses in botany are taught at Washington and St. Louis Universities, and considerable time is spent with graduate student programs and theses. The following list of students, thesis topic, and degree, if completed, suggests the Garden's involvement as a force in graduate education.

Joan W. Nowicke, Ph. D., Palynotaxonomic revision of the *Phytolaccaceae*.

Sister Mary Victoria Hayden, Ph. D., Systematic morphological study of New World rubiaceous seeds (*Rubioideae sensu* Bremekamp).

Olga Herrera, M.S., Revision of the Panamanian species of *Psychotria* (*Rubiaceae*).

Joseph H. Kirkbride, Jr., M.S., Revision of the Panamanian species of *Rondeletia* (*Rubiaceae*).

Ray Altevogt, Phylogeny of *Medicago* (*Leguminosae*).

Daniel F. Austin, Monograph of *Maripa* (*Convolvulaceae*).

Thomas S. Elias, Revision of *Hamelia* (*Rubiaceae*).

Jon L. Hawker, Floristic study in northern Costa Rica.

Bruce MacBryde, Revision of *Galphimia* (*Malpighiaceae*).

Kenneth R. Robertson, Revision of *Jacquemontia* (*Convolvulaceae*)

Research in Hybrid Vigor

DR. ANDERSON formally retired late in 1967. He has, however, continued to work a full day in his office in the Museum Building.

Early in 1968, Dr. Anderson published a revised and extended guide to the dangerous poison plants in the St. Louis area. The guide is used by emergency rooms of hospitals, interested physicians, and professional and amateur botanists. Dr. Frank Mercer, Director of the St. Louis College of Pharmacy, has been helpful in extending and revising the list. A new edition will be published early this year.

On six successive Saturdays from late March until early May Dr. Edgar Anderson taught "The Dynamics of the Landscape" at the Garden's Arboretum in Gray Summit. The course examined not only the identification and distribution of the spring flora but also the effects of the species on each other and their interactions with the environment. The consequences of lumbering and pasturing on the original flora were dramatically demonstrated. As in previous years, the students were teachers, amateur horticulturists, undergraduate botany majors, graduate and post-graduate students, and staff.

Kenneth Peck and Dr. Anderson conducted an evening lecture and Saturday field trip in winter botany.

Dr. Anderson continues basic research on his long range study of useful plants, genetics, and plant breeding. Mr. Ray Altevogt worked closely with him on alfalfa research.

In July and August, Dr. Anderson's research was conducted in the extensive breeding plots of Pioneer HiBred Corn Company in Johnson, Iowa. He investigated new approaches of measuring hybrid vigor, the restrictions to character recombination in wide crosses, and the relationships between several oriental varieties of popcorn. He is a consultant to Pioneer HiBred Corn.

USEFUL PLANTS

Hugh C. Cutler

THE RESEARCH in useful plants was directed toward the evolution of corn, squashes, pumpkins, and the bottle gourd. These are ideal plants for the investigation of parallel development of domesticated plants and human cultures because there are abundant archaeological devices and materials to document prehistoric changes. Many varieties of these plants are grown today and can be cultivated in Missouri. There are many wild relatives which will hybridize with the cultivated species to produce new forms.

The Garden has a long tradition of work on man-related plants. In the mid-19th Century the Garden's founders, Henry Shaw and his advisor Dr. George Engelmann, published monographs on cultivated plants. The Herbarium, Library and Museum Building contain some of the best reference materials on the origin and development of domesticated plants. There is an active exchange of materials and unpublished ideas among the many past students, visiting researchers, and the present staff and students.

Since 1953 the Museum Building has been a center where the collections and reports of archaeologists, economic botanists, ethnologists, geneticists, geographers, plant breeders, and taxonomists could be brought together for research on the evolution of cultivated plants. The Garden is now the most active center for the study of domesticated plants of the New World. We cooperate with about 75 other institutions devoted to the study of archaeological and modern plant collections. A part of the salaries and travel is supported by grants from the National Science Foundation. Some field work is supported by cooperating institutions.

Mr. Leonard Blake continued his work on useful plants found at archaeological sites. He maintains liaison with the many archaeological groups in Illinois and Missouri.

Methods devised at the Garden for floating and recovering vegetable materials from soil have been widely adopted. As a result the Garden has received plant remains from several areas and time periods for which there were no previous records of agriculture. Results of the work done at the Garden were presented at local, state, and national meetings and conferences and have been widely published in scientific journals.

Fifteenth Annual Systematics Symposium

On October 18th and 19th, 210 botanists and zoologists assembled at the Garden to discuss "The Practical Values of Systematics". Four papers on different aspects of the subject, based on research from plants and animals, were presented. This was followed by an active discussion directed by the chairman, Dr. Donovan Correll of the Texas Research Foundation. Many of the participants came early and remained after the meetings to consult with our staff and to use our Library and Herbarium. The Symposium was designed by Dr. Hugh Cutler and supported by the National Science Foundation.

ECOLOGY

David M. Gates

ONE OF THE primary objectives of ecology is to understand the detailed interactions between plants, animals and their environment. It is eminently clear that to understand the ecological processes one must utilize the scientific knowledge of physics, chemistry, and biology—and use mathematics as the main integrating tool. When this is not done, ecological understanding is obscured. The ecology program at the Garden undertakes to incorporate in the teaching of ecology a detailed recognition of the processes of physics coupled to the physiological processes within plants and animals.

The Ford Foundation recognized the uniqueness of our program in biophysical ecology and granted $420,000 to the Garden for a five year program of training biophysical ecologists. Support is included for four doctoral candidates and two post-doctoral fellows, as well as a computer programmer and an assistant director for the project. The Ford Foundation recognizes that one of the greatest problems facing mankind today is the proper management of the environment. In order to cope with the massive environmental problems which confront our civilization we must train people who are well grounded in modern ecology. In order to correct the acute shortage of trained modern ecologists, the Ford Foundation supports a

number of related programs throughout America. The Garden was selected as one of the primary centers for training and research in ecology. Ecology research at the Garden is supported by the United States Atomic Energy Commission and the Office of Naval Research, in addition to the Ford Foundation.

All plants and animals must live on this earth in energy balance with their environment. If an organism is receiving more energy than it is giving out, then it will get hotter and hotter. If, on the other hand, an organism is receiving less energy than it is getting rid of, then it will get colder and colder. Clearly, neither imbalance will permit the organism to survive. Therefore, every organism must be in energy balance with its surroundings over an extended period of time. On this principle we have analyzed the energy budgets of animals. From this analysis we have been able to predict the microclimate within which an animal must live to survive. This analysis is an extremely complicated procedure. Climate is comprised of solar radiation, wind, air temperature, and humidity. These are four variables each depending upon time. In addition, an animal has several properties which may be variable with time and affect its interaction with its environment. These properties include the animal's metabolic rate; moisture loss rate; insulation by fat, fur, or feathers; and body size, color, etc. The consequence of the energy flow between the environment and the animal must be such that the animal's body temperature remains near a specific value for a homeotherm (warm blooded animal), or within a broad range of values for a poikilotherm (cold blooded animal). The energy budget analysis of animals is a multi-dimensional problem with as many as eight or ten variables. However, we manage to identify the analytical equations expressing the energy transfer between an animal and its environment and from these produce a solution to the problem. We have predicted the combination of radiation, wind and air temperature comprising the climate within which the following animals must live to survive: desert iguana, pygmy shrew, zebra finch, cardinal, chipmunk, ground squirrel, jack rabbit, sheep, and pig. We are finding that these animals actually live where we predict they should. Furthermore we can predict their behavior within specific climatic conditions.

The energy budget analysis of animals was conducted by Dr. Warren C. Porter, who came to the Garden two years ago as a post-doctoral fellow from U.C.L.A. He completed his Ph.D. degree under Dr. Kenneth Norris. Dr. Porter is now Assistant Professor of

Zoology at the University of Wisconsin. Dr. Oscar Soule, who joined the Garden staff in September 1968, is continuing the energy budget analysis of animals.

Dr. Hyrum Johnson joined the group in January 1968 as a post doctoral fellow. He came to the Garden from the New York Botanical Garden where he completed his Ph.D. degree under the direction of Dr. Pierre Dansereau. Dr. Johnson is working on the problem of energy exchange between leaves and environment with particular emphasis on gas exchange and the influence of pubescence. Dr. George R. Hoffman came from Oak Ridge National Laboratory in September. He will expand the energy exchange research to whole plants.

Dr. Fred Lanphear, Associate Professor of Horticulture at Purdue University, came to the Garden in June to spend his sabbatical year working with the biophysical ecology group on two major problems: the absorption of noise by vegetation, and the specific effect of air pollutants on vegetation. Dr. Lanphear has set up a noise generator which he can locate near a stand of vegetation and measure the sound intensity at various distances from the source. He is comparing the reduction in sound intensity through vegetation of various types, with the transmission of sound in open space. We feel that the use of vegetation for meeting some of our social problems is crucial. Vegetation quiets a noisy urban community, cleanses and cools the air, slows down the wind, and produces shade from radiation to make the urban environment a more pleasant place in which to live.

Mr. Ronald Alderfer, a Ph.D. student in biophysical ecology, is doing a thesis on the energy budget of plant canopies. This problem requires a great deal of complex mathematical analysis and is

an extremely difficult one. The plant canopy interacts in a complex way with radiation, wind, moisture, carbon dioxide and oxygen exchange, and other factors. Mrs. S. Morhardt, a Ph.D. candidate, is beginning to work on a problem involving the relationships between the food chain of plants and animals and the thermodynamic energy exchange. This will be the first time that the thermodynamic approach has been combined with the understanding of the food chain. Mr. Elwynn Taylor, a Ph.D. graduate student, has undertaken a thesis concerning leaf morphology and energy exchange.

During the year, two field trips were taken by the ecology group; the analytical techniques used by our groups substantially enhanced the understanding of ecosystems.

Oak Ridge Field Trip

Hyrum Johnson

IN MAY OF 1968, Elwynn Taylor and Hyrum Johnson, biophysical ecological research scientists, spent ten days experimenting at the Oak Ridge National Laboratories (ORNL) and the Great Smoky Mountain National Park in Tennessee. Steven Bryce, a high school senior, served as a "trip technician."

The purpose of the trip was to study the energy budget relationships of plants under field conditions. The two areas visited are extremely well suited for this kind of investigation since much of the needed background information has been accumulated by previous investigators.

What is becoming a well known "Tulip Tree Forest" at ORNL was of primary interest. Ecologists at Oak Ridge have spent many years measuring the environment of the lareodendrum forest and the cycling of nutrients and organic matter in this forest. Here, leaf temperature profiles in relation to water utilization were studied. The Great Smoky mountains were of special interest because of the contrasting vegetation found there: sharply defined heath balds and adjacent forests—low vegetative patches beside towering stands of timber.

Field measurements not only provided new raw data but also contributed much needed practical experience under direct field conditions. This project provided the necessary preparative procedures for the more extended Michigan field trip later in the summer, which involved the entire ecology research group.

The trip was supported by the Atomic Energy Commission and the Oak Ridge National Laboratory.

Michigan Field Trip

Ronald Alderfer

THE ECOLOGY RESEARCH group* worked at the University of Michigan Biological Station, Pellston, Michigan, from July 22 to August 16, 1968. The purpose of this project was to study changes in the native vegetation of northern Michigan following the deforestation which occurred during the early part of this Century. Several experimental study plots on the Biological Station grounds greatly aided this work.

The group did research in three specific areas.

FIRST: Taylor and Johnson compared the water usage of the three major stands of vegetation: bracken fern, a pioneer plant, (i.e., it grows shortly after land clearing and before other plants get established); the quaking aspen; and the big-tooth aspen. The latter two trees occupy deforested lands after pioneer plants but before pines do. Taylor and Johnson also determined energy budget equations for each of these plant stands.

SECOND: S. Morhardt and Alderfer measured the spectral quality and penetration of sunlight and thermal radiation in certain tree canopies, particularly the aspens. They constructed temperature

*The group included Dr. David Gates, Director, Ronald Alderfer, Dr. Hyrum Johnson, Dr. Emil Morhardt, Sylvia Morhardt, Dr. Warren Porter, and Elwynn Taylor.

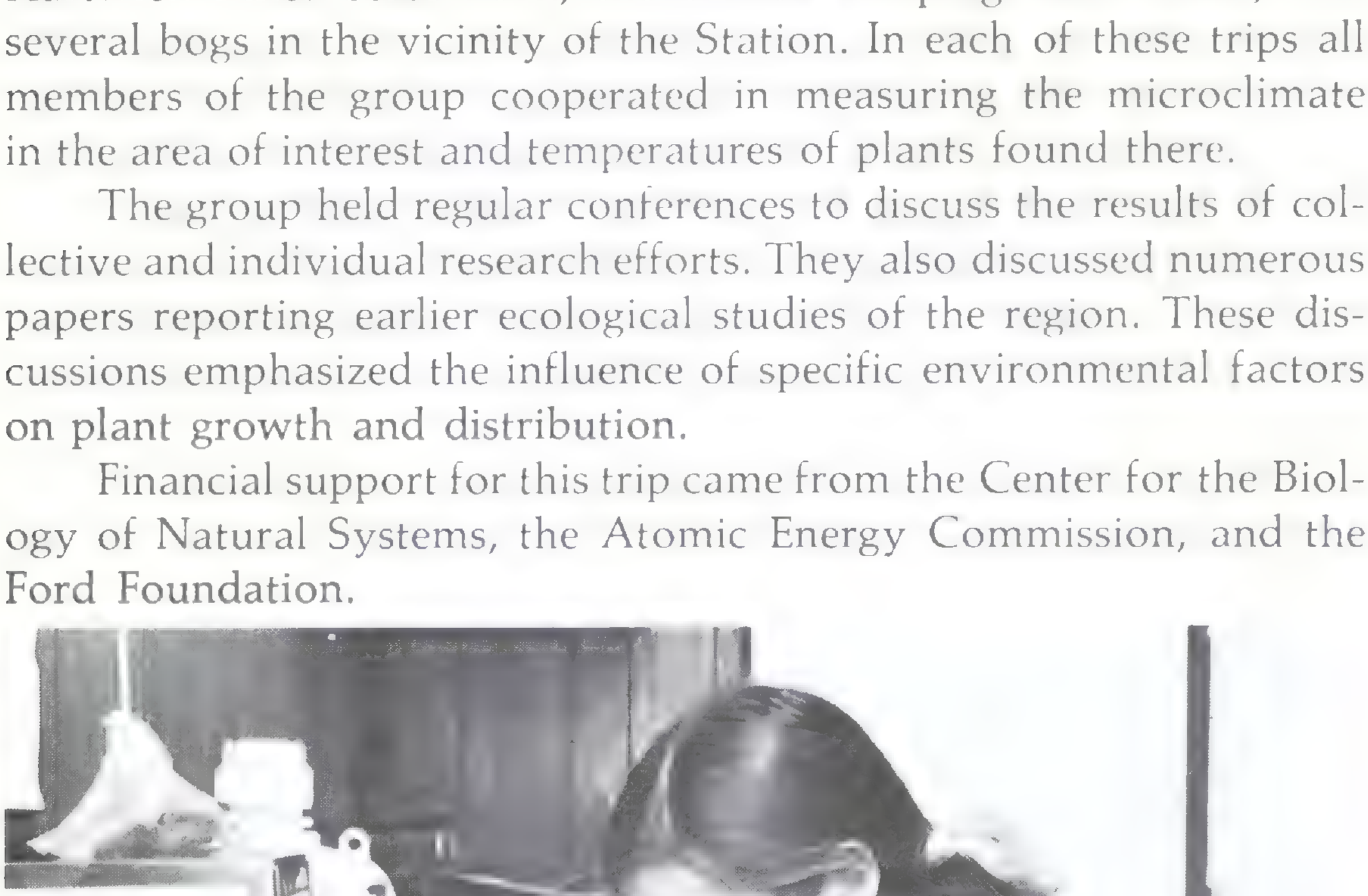
and light intensity profiles for each canopy on the basis of their measurements. One important result of these studies is a better understanding of the productivity and water consumption of each segment of the canopy throughout the entire day.

THIRD: Porter and E. Morhardt determined the water loss rates, body temperatures, and surface temperatures of small animals native to the region. Morhardt developed a method to separate the fraction of total loss due to sweating from that due to loss from the respiratory tract in breathing. These measured values of temperatures and water loss rates were compared with those calculated theoretically by Porter and Gates.

The group also studied (collectively) certain local areas including the beach and sand dunes around Sturgeon Bay (on Lake Michigan), the last remains of the native mature pine forest in the Hartwick Pines State Park, the eroded Sleeping Bear Dune, and several bogs in the vicinity of the Station. In each of these trips all members of the group cooperated in measuring the microclimate in the area of interest and temperatures of plants found there.

The group held regular conferences to discuss the results of collective and individual research efforts. They also discussed numerous papers reporting earlier ecological studies of the region. These discussions emphasized the influence of specific environmental factors on plant growth and distribution.

Financial support for this trip came from the Center for the Biology of Natural Systems, the Atomic Energy Commission, and the Ford Foundation.



THE ARBORETUM

Andrew L. Johnson

FOR OVER FORTY YEARS the Arboretum at Gray Summit has developed quite differently from most of the land holdings in Franklin County. Trees and shrubs have arrived for planting from many parts of the world. Lakes have been constructed and stocked with fish. Trails were developed and signs identifying some trees and shrubs erected. The Arboretum gradually became a unique feature in the rural Missouri landscape.

In an era of rapid expansion and creeping suburbanization, however, the thirty-five miles that lie between the Arboretum and St. Louis seem to afford little future protection for rural and natural qualities. What will become of the Arboretum in the future? How

can the staff at the Missouri Botanical Garden make sure that the Arboretum will be used effectively and not abused or exploited? These are two of the questions we are now asking. To help answer these questions and provide a workable plan for future development, we are studying the potential uses and support for this area.

An arboretum, in its classic sense, is a testing area for exotic species. Arboretums provide information about how well plants not endemic to an area, do in an unnatural climate. Today information about success of exotics is perhaps less important than it was fifty years ago. The study of individual species of ornamentals is less critical than the maintenance of natural areas in a stable and diverse condition.

Some would have the gates to the Arboretum closed and little publicity given to this resource. Others may wish that more was being done there. To best arrive at a balance between these viewpoints, careful planning will be conducted before any changes are made. It is hoped that programs at the Arboretum can be developed that will please most interested persons.

One primary objective of our planning will be to use the Arboretum as a center for environmental conservation activity. The center will provide illustrations of ecological concepts; it would promote the wise use of land and research problems pertinent to maintaining natural landscapes. At the least, this program will insure that the land is managed and maintained in a manner that utilizes the best techniques of ecological theory and practice. The most that would be expected is that the Arboretum would develop into a regional center for environmental conservation activity, to provide educational and recreational opportunities and take an active role in basic and applied ecological research. The two most pertinent points that must be emphasized are 1) The Arboretum will remain a vital part of the Missouri Botanical Garden, drawing on the Garden's resources and staff, and 2) The Arboretum is centrally located to provide information to the public about the lands they visit and the psychological value they can gain from natural landscapes.

Most of the habitats at the Arboretum are the result of the process of natural succession. Each species of plant and animal that maintains itself at the Arboretum plays some role in the natural community. The trees, for example, provide shade and oxygen, assimilate CO_2, convert nutrients, alter rainfall patterns, stabilize developing soil, and perform other functions. Less obvious, perhaps, are the hundreds of species associated with these trees. One of the most complete ecological surveys ever conducted is that by Charles

Elton at Wytham Hill, England. Speaking of an area of about two square miles, similar in size to our Arboretum, Professor Elton writes: "At the date of writing (1964) we actually know of about 3,800 species, and allowing for our ignorance still of a good many groups of animals and of certain communities (such as marshes, woodland soil, arable land, meadow, vegetation and river) one can hardly believe that there are less than 5,000 species altogether, and not improperly a good many more than that." The point is that the Arboretum undoubtedly contains as many species of organisms as Wytham Hill and each species contributes to the life process and helps maintain the landscape in a natural balance.

Ecologists realize that their findings reach to the very fundamental questions of survival of the planet Earth. It was a different story in the past when men could alter the structure of natural communities in only minor local ways. But we have gradually begun to take heed of our actions and to realize man's terrific impact on the natural world. It may seem to most that we can manage nature as we wish. But to blindly alter natural processes on large scale is to court disaster.

The Arboretum provides examples of several communities of organisms, and these communities each function through an interaction between individual species and the total environment or "Biosphere." It is this small envelope surrounding the Earth upon which all life depends. The biological processes that take place within the Arboretum boundaries are repeated, with variations, all over the world and contribute to a stable system. Each protected area provides a refuge for species of plants and animals, some of which are now nameless. Obviously, there is less information about their role in the total picture. How many species of bacteria live within the Arboretum boundary? We may never know for sure. This is not to say we don't understand that they play some role and do some work. When we talk about conservation in 1968, we mean conserving the vital processes that keep "Spaceship Earth" functioning properly.

The role of the Arboretum will hopefully be one of explaining and illustrating these vital processes upon which all life depends, and researching aspects we know little about. It is a big task, but one we can grow into. The important thing is that we understand the necessity to maintain healthy communities of organisms and work toward understanding why and how they maintain themselves. As we develop this understanding we can better inform the public. Together we can work toward a healthy balance between man's action and nature's response.

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A group of children from the Tandy area (15 asked to come and 53 arrived) came to the Garden to learn seed sowing. They returned a few weeks later to pot the seedlings. Each child planted his seedlings at home. Surplus plants were used to develop a garden behind the Urban League field house. Maintenance on these gardens throughout the summer was done by the local residents. The Garden staff gave continued advice and counsel.

Other children, from Youthpower, were taught the fundamentals of lawn care. This information was the basis for earning money by kids who might have spent the summer in idleness.

TOWER GROVE HOUSE

Mrs. Jerome F. Kircher

IN 1954 THE COUNTRY HOME of Mr. Henry Shaw was opened to the public. It is an important historical landmark for the Missouri Botanical Garden and St. Louis.

The year 1968 has been a busy and successful year. The Historical Committee has made necessary repairs to the Shaw house to keep it and the furnishings in top condition. Air conditioning has been installed.

The Historical Committee has maintained the decor of the period; the restoration has been authentic. For example, there are no synthetics—only wool, silk, and cottons have been used in the house on chairs and curtains. Ingrain rugs are in two bedrooms and both upstairs and downstairs back halls.

35,000 paying guests and 4,000 school children visited Tower Grove House in 1968. Our manager, Mrs. Virginia Brewer, has met situations with professional expertise: she has shown the house to one hundred and forty children at 11:00 a.m. and at 12 noon guided a group of ladies old enough to remember some of the artifacts from their own childhood.

Seventy-five volunteer hostesses help at various times—on regular weekly schedules, or as needed when large groups have been scheduled. Every year we have a combination training program and refresher course for our volunteers, new and old. Our annual picnic is a rewarding experience.

Mrs. Orrin Miller, flower chairman, keeps fresh flowers in the House. Mrs. Mary Baer presents the House with dried arrangements, necessary in the cold winter months. Our winter decorations, in keeping with the Holiday Season reflected the 19th Century motifs popular with Mr. Shaw and his contemporaries.

On July 21st the Repertory Opera Theatre presented a special concert on the lawn outside the House honoring Henry Shaw's birthday. Birthday cake and punch were served afterwards.

Tower Grove House participated in the "Display of Shaw's Garden" July 22 through August 3, at Crestwood Plaza. Our window display of furniture and mementos of Shaw House received notable attention.

A reception was held for the St. Louis String Quartet (sponsored by the Mark Twain State Bank) in July. These talented young men played some of Henry Shaw's favorite music. Refreshments served were made from recipes in the Shaw House Cook Book.

In September, the Veiled Prophet Queen and her Special Maids were at the old House to receive the school children.

The Historical Committee responsible for maintaining this St. Louis cultural attraction consists of Dr. David Gates, Mr. George Brooks, Mrs. John S. Lehmann, Mrs. Neal S. Wood, Mrs. Robert E. Koch, Mrs. George Pettus, and Mrs. Jerome F. Kircher, chairman.

The horticultural societies throughout 1968 continued to expand their activities at the Garden. Their contributions promote new community participation in botanical projects.

The Missouri Botanical Garden Calendar

(JANUARY-FEBRUARY, 1969)

January 1 . . . . . New Year's Day. Garden closed.

January 2-5 . . . . . POINSETTIA SHOW

January 4 . . . . . CHILDREN'S SATURDAY NATURE PROGRAM. "Winter Puzzles." 10:00-11:30 a.m. Admission is free.

January 11. . . . . CHILDREN'S SATURDAY NATURE PROGRAM. "Jungle Plants." 10:00-11:30 a.m. Admission is free.

January 12
thru February 2 PRIMROSE AND CYCLAMEN SHOW

January 18. . . . . CHILDREN'S SATURDAY NATURE PROGRAM. "Life Secret of a Plant." 10:00-11:30 a.m. Admission is free.

January 25. . . . . CHILDREN'S SATURDAY NATURE PROGRAM. "Table Top Greenhouses." (Bring a 1 lb. coffee container and plastic bag large enough to cover.) 10:00-11:30 a.m. Admission is free.

February 1. . . . . CHILDREN'S SATURDAY NATURE PROGRAM. "Trees and Forests." 10:00-11:30 a.m. Admission is free.

February 8. . . . . CHILDREN'S SATURDAY NATURE PROGRAM. "Mystery of the Orchid." 10:00-11:30 a.m. Admission is free.

February 9
thru March 23. . . ORCHID SHOW

February 15. . . . . CHILDREN'S SATURDAY NATURE PROGRAM. "Nature Movies." 10:00-11:30 a.m. Admission is free.

February 18. . . . . BUDDING AND GRAFTING. To be taught by Mr. James I. McCaskill in the Museum Building. $6.00 for Friends of the Garden; $8.00 to others.

February 22. . . . . CHILDREN'S SATURDAY NATURE PROGRAM. "Pin Cushion Forests." 10:00-11:30 a.m. Admission is free.

(For further information call 865-0440)

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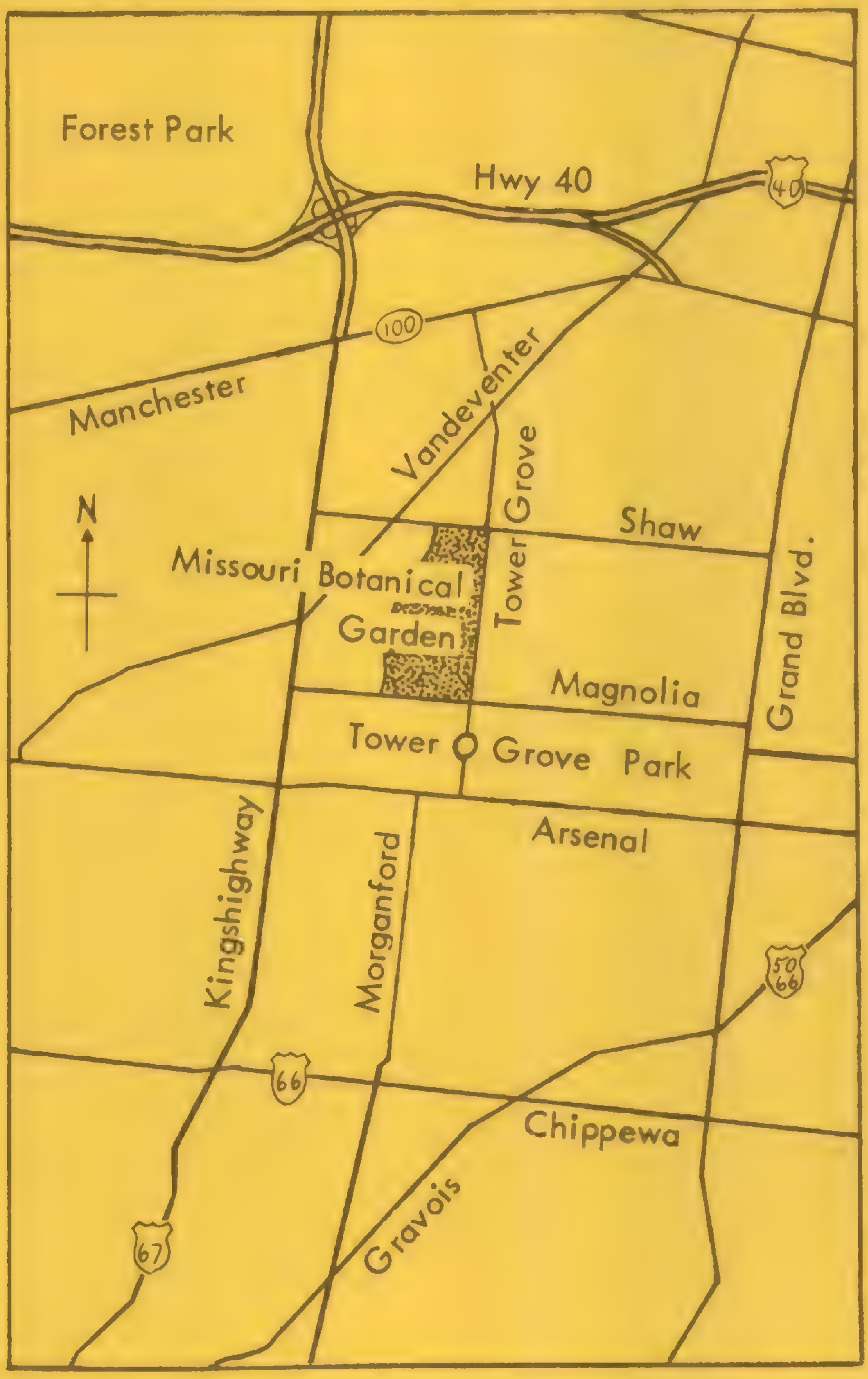
(SHAW'S GARDEN)



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MISSOURI BOTANICAL GARDEN

BULLETIN

VOLUME LVII NO. 2

MARCH-APRIL 1969

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From the Director

The more civilized and industrialized mankind becomes, the more critically dependent man is upon plants for his own survival. The more crowded the planet Earth is with people, the greater is the demand for food—and all food of every kind is derived from plants. The entire Earth ecosystem, its atmosphere, its soil, and its incredible diversity f organisms, is driven through daily and annual cycles of activity y sunlight. But only plants convert sunlight to useful forms f chemical energy through primary productivity of photosynthesis. eefsteak, lamb chops, and lobster all depend upon plants for food. ll are a part of the fantastically complex food chain of nature.

The coal we burn to heat our homes, the natural gas that drives ur industries, the gasoline which propels our automobiles and airlanes, all derive from plants. All life depends upon respiration, a rocess requiring oxygen. Without oxygen we would die and so ould all life be stilled. The only, I repeat, the only major source f oxygen in our atmosphere is the photosynthesizing plant-covered urface of the Earth. Manufacturing would collapse without oxygen fan the furnaces of industry.

Water is evaporated into the skies by sunlight acting on the urface of plants. The vegetation of trees and shrubs and grass protects the soil surface against water erosion, wind weathering, and olar drying. Plants quiet a city by absorbing the noise about us, nd shield us from one another to keep us from going mad from he constant pressure of the crowds. Fortunately we can still escape rom the concrete of the city to the green countryside, the cool reams, and shaded forest.

Man depends upon plants; there is no denying or evading this. et the institutions of the world devoted to the quiet, exciting, cholarly pursuit of knowledge about the plants are unbelievably ew. The Missouri Botanical Garden is a member of that elite society f institutions which are totally dedicated to a better world through nowledge concerning plants. Your support is needed now.

David M. Gates

MISSOURI BOTANICAL GARDEN BULLETIN

VOLUME LVII NUMBER 2 MARCH-APRIL 1969

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COVER: *Design by Peter Geist*
Illustration from a woodcut of the violet
the *Latin Herbarius* printed by Peter Schöff
in Mainz in 1484.

GARDENING IN ST. LOUIS

MARCH AND APRIL

MARCH STIRS the soul and ambition of even the most casual gardener. The smell of spring is in the air, inspiring plans for vast expanses of bluegrass or zoysia, bowered patios, scented herb gardens, lush beds of annuals and perennials.

Any major plans for new beds, patios, and so forth should be scale-diagrammed on paper for best results. Keep in mind not only height but eventual spread and growing habits of both woody and herbaceous plants.

All tools and equipment should be clean and in good repair, ready for the busiest season of a gardener's year. When the soil is dry enough to be workable, and all danger of blustery freezing weather is gone, sow hardy annuals, vegetables, and herbs outdoors. Cold frames or seed flats for the more tender plants may be prepared and planted in late March.

Don't let a spell of false spring lure you into uncovering roses and perennial beds before April 1st. The late summer and fall-blooming plants and shrubs should be divided, transplanted, and pruned as needed.

A general fertilizer such as 10-10-10 is good for everything at this time. Work in mulches, composts, finely cut trimmings on a regular basis, and your garden soil will improve in both workability and fertility.

Pre-emergence crabgrass killer should be applied to lawns before apple blossom time, following instructions carefully. Spraying for pests or diseases should be done with a definite purpose in mind. Learn to recognize the common causal agents and symptoms. Haphazard shotgun techniques will reap more harm than good and are also costly.

In buying nursery stock, choose only the sturdy specimens of varieties proven successful in our growing zone. Exterior decorating can be easy and effective, using up-ended drain tiles, tubs, or other containers. Plant geraniums in some and herbs such as mint, basil, or rosemary in others.

THE VIOLET

Peter Schöffer's *Latin Herbarius*

Carla Lange

THE ILLUSTRATIONS on the covers of this year's Bulletins are copied from Peter Schöffer's *Latin Herbarius* (also known as *Herbarius Moguntinus* and in Italian translation, *Herbario in Latino*, etc.). It was printed by Peter Schöffer in 1484 in Mainz and was the first herbal printed in Germany with woodcuts of plants; all native to Germany or garden plants grown there in the 15th Century. In his *Latin Herbarius* Peter Schöffer gave them their German names as well as their Latin names, for the descriptions of the virtues of these plants are in Latin. The book became very popular and similar herbals were published in other cities of Germany, Italy, and France.

The work is anonymous. It is a compilation from works of various authors, from manuscripts probably written before 1300. It seems quite possible that Peter Schöffer might have found an old manuscript in some library and committed it to press. The work contains a description of 150 plants, in alphabetical order. Wilfrid Blunt, in his *Flower Books and Their Illustrators*, states that "the illustrations though not without boldness and decorative charm, are largely symmetrical, correct proportion is rarely attempted, the flower usually being conventional." Heilmann in his recent book, *Krauterbucher in Bild und Geschichte*, remarks that obviously at that time no experienced artists for this type of work were available since Schöffer tried a new technique and had the drawn plant cut in wood-blocks. In all probability, Heilmann continues, the wood-cuts were executed by artists who made the wood-cuts for old German playing cards.

Even though Schöffer printed a large number of his first edition, and followed this with two more editions, apparently only fourteen copies of this work are presently known to exist. According to Klebs

in *A Catalogue of Early Herbals; mostly from the well-known library of Dr.Karl Becher, Karlsbad,* perhaps only one copy of the 1484 edition of Peter Schöffer's *Latin Herbarius* with uncolored illustrations exists in the United States; that copy with its original binding of dog's skin is in the rare book collection of the library of the Missouri Botanical Garden.

Very little is known about the man Peter Schöffer himself. He was born in Gernsheim, a small German town, and in all probability received his early education in Mainz. He apparently continued his studies in Paris, returned to Mainz in the middle of the 15th Century, and joined Johannes Gutenberg who had made the first practical application of the printing press to the production of impressions from movable type. It was certainly from Mainz that this art spread throughout the cities, first in Germany, and later in Italy and France.

Gutenberg's name stands on no title-page. The fact, however, that the full responsibility for the initial success of the printing press belongs to him is borne witness to by his contemporary, Peter Schöffer, and others. The historical date now given for the publication of the first printed book is August, 1450, for in one copy of Gutenberg's Bible there is a written statement so dated. At this time, Gutenberg entered into a contract with Johann Fust, a wealthy citizen of Mainz, under which Fust loaned to Gutenberg the sum of 800 gulden in gold, two years later adding another 800 gulden. Gutenberg was unable to repay this debt and a lawsuit arose between him and Fust, which was won by Fust, who then took over the Gutenberg press. Fust then associated himself with Peter Schöffer. Fust died in 1466, and Peter Schöffer, who later married Fust's daughter, eventually became the sole owner of the Gutenberg press.

The plant illustration of this issue of the Bulletin is that of a violet, and according to the *Latin Herbarius* violet oil may be made by steeping violet flowers in olive oil. Sugar of violets is made by mixing the juice of violets with white sugar. The book goes on to suggest the 15th Century medicinal uses of violets. An ointment of this violet oil placed outside over the liver is useful in treating inflammation of the liver. Further, the ointment put on the temples and forehead drives away the heat of a headache and induces sleep. Moreover, violets applied to a heated abcess is immediately relieving.

Herbals such as this rare old edition served as medical manuals for physicians of that time.

Paul A. Kohl

CALCEOLARIA

Edgar Anderson

AT THE SPRING flower shows, visitors have been increasingly fascinated by small displays of potted calceolarias, used here and there as accents to point up the main exhibition. The jolly little yellow flower (no larger than the end of a pencil) of the wild species native to the high Andes of South America have been enlarged and varied by cross-breeding and selection. It is hard to believe that these sophisticated blooms, set so close together that they look like mounds of brilliant decorated candies rising out of the flower pots, have anything to do with the little blossoms one can see fluttering in the wind on the upper slopes of a volcano in the Andes. All they have in common are bulging curves of yellow and an air of gaiety. One of their common names in Spanish, *Boton de Oror* (Golden Button) is no longer appropriate for them; but another, *Porta-moneda* is more descriptive than ever, and translated into English as "pocket-book flower" is being used more widely.

The scientific name, *Calceolaria*, also refers to the two bulging lips of the corolla since it is derived from the Latin *calceolus*, "little show," it is often listed in books as "slipper plant" of "slipperwort", though this is a misleading common name since cypripediums and other similar orchids are widely known as slipper orchids or lady's slippers.

The genus *Calceolaria* numbers some hundred or more species, most of them native to the high Andes, a few of them coming as far north as Mexico. One of these, *Calceolaria mexicana*, which was apparently originally native along brooksides on Mexican volcanoes, has given rise to an engaging little roadside weed which turns up in such odd corners of the tropics as mountain valleys in Sikkim or the highlands of Java.

Claude Johnston

WINTER VISITORS IN THE GARDEN

Edgar Anderson

THE FIRST SUNDAY after Christmas in 1968 was cold and windy with sunshine only for short periods at midday and in ate afternoon. There was not enough snow for sleds; it was much oo hard to make snowballs; and the blustery cold discouraged photo-graphers. Those who enjoy a world draped in snow virtually had he outdoor Garden to themselves. Others either stayed at home or onfined their visits to greenhouses. But there were many who did ome, dressed for the low temperature and strong wind in warm ports clothes, some very smartly turned out, others in the kind of plain, practical winter garments worn by delivery men in icy veather. A good many came as family groups. There was a sprinkling of gray-haired grandparents as well as those who looked hale, hard-ned by frequent vigorous exercise. They were all delighted with the now. And on this particular Sunday it was most unusual. As wet now just beginning to freeze, it had been thrown violently against rees and shrubs by strong gusty winds. It soon froze into solid crusts, which made fascinating patterns with the evergreens, the hardy amboos, the big old trees, the shrubs with traceries of small inter-woven branches.

The Garden's open spaces with views of sky and clouds and rees are rare in the midst of an ever larger, ever denser urban area. As I watched these visitors come and go on December 29th, I wondered ow many of them had looked out of their windows at home and nought: "With snow of this sort, Shaw's Garden must be extra-pecial today. Let's dress up warm and go and explore it."

ENJOY YOUR YARD

Derek Burch

THERE IS NO DOUBT that maintaining a yard can be the wors
drag in the world for someone who does not enjoy gardening
The American dream of a house with a patch of land can becom
an All-American nightmare when the realities of keeping the piec
of ground mown and clipped and reasonably weedfree are faced

Even those who are fond of gardening enjoy some parts of th
work much more than others. A sensible approach to solving thi
problem in any size garden is to decide which operations you enjoy
concentrate on them, and cut back as much as possible on the others
For the non-gardener this might be translated as getting the drudger
out of the way quickly so that sitting in the lawn chair under a shad
tree with a cool drink can be enjoyed with a clear conscience.

There *are* many corners to be cut and labor-saving devices t
be used so that even the most enthusiastic gardener can more ofte
enjoy the pause on the patio. The first step in being successful wit
this new concept of gardening is to disregard much of what you hav
already learned about maintaining your garden: the neat path
between immaculately cut and edged lawns, surrounded by
beautifully raked flowerbeds of constantly changing colorful dis
play; trees in the yard with lower branches removed so that gras
will grow underneath them; perfectly matched, clipped evergreens
in the foundation planting, all kept to the size shown in the nursery
man's drawing, regardless of their natural tendencies.

I am far too lazy to accept any such standards for my garden
My small city plot is surfaced with brick set in sand, and all my

growing is done in containers or flower beds with raised sides which double as seats both for planting and weeding, and for social occasions. All planted areas are heavily mulched to reduce weeding, and I use annuals to give summer color in a framework of shrubby material that maintains a certain interest in the winter. If I lived in the country with a larger lot, my approach would be quite different. I would welcome an area for intensive vegetable gardening and would combine a reasonably well-kept area near the house, with natural looking vegetation over the rest of the area.

If you are ready to forsake traditional planting methods and adopt a more relaxed approach to your garden chores, I recommend that you first read Ruth Stout's *Gardening Without Work*. The first notion that Miss Stout discards is that planting areas must be *kept clean* and *weedfree*. In her words: "My garden is my compost heap—and looks it." She has long given up digging and instead spreads all material that will rot on the surface of the ground, pulling this aside to put in her seeds or plants.

There is a great deal of worm and micro-organism activity breaking down this rich surface layer to make the food available for the plant roots. The mulch also assists in keeping the soil moist and effectively prevents weed seed in the soil from germinating. It means a radical change of approach to appreciate the beauty of an even layer of mulch over the whole garden, but I have been doing it long enough to feel uncomfortable when I see bare soil.

I have found that the mulch method is particularly successful in planting new areas. If you have the space, you might care to experiment with it in an out-of-the-way place in your garden. If the area has plant growth already on it, whether weeds or grass sod, the first step is to lay out the area with several layers of newspaper. There seems to be no difference in the compostability of our two local papers, but do make certain that each section overlaps the adjacent pieces and that there is a good thick cover. This will kill vegetation underneath and prevent weed seed germination for at least a season.

The newspapers should be covered with a thick layer of any compostable material and plant remains, either fresh or remains of the compost heap, sawdust, wood chips, spoiled hay, or anything available in bulk serves equally well. This layer has the double purpose of preventing the paper from blowing and of hastening its rot-

ting to enrich the soil. This may be done at any time that the ground is not frozen.

When you are ready to plant, you simply force a spade or trowel through the compost and newspaper and drop a seedling into the slit, pulling the compost loosely around its neck. If the plants have already been started in individual peat pots, you may lift the newspaper and compost back, put the pot right on the surface of the ground and bring the compost back around it.

This type of surface mulching is particularly successful for breaking down, feeding, and keeping the soil moist. The tremendously active population of earthworms and micro-organisms aereate the soil well and keep the food in the soil constantly available as the short-lived fungi and bacteria die and their bodies are in turn broken down by a new generation.

The mulching is also effective in preventing weed seeds in the soil from germinating, and any weed that develop from weeds that blow into the compost or grow up from persistent roots in the soil, are very easily pulled up from the loose compost with much of their root system intact. These weeds, of course, are simply dropped where they are pulled and themselves form part of the mulch there. Small cuttings, leaves, small prunings, and the remains of vegetables cut for the house go right onto the surface layer. Is there any doubt that our garden has become our compost heap?

There are other mulching materials that aid in moisture control and in discouraging weeds. Stones are effective but can make future planting rather tricky. Plastic sheet is very effective as a surface cover and weed smotherer and allows planting by jabbing something sharp through the sheet in order to get the seedlings into the soil below. There are many other labor-saving devices now on the market.

The chemists have been very active in developing weed killers that may be applied between growing plants without harming them but which kill all weed seedlings as they try to penetrate the poisonous surface layer. There are other materials for preventing all growth from areas such as paths. The only danger with these is that they are completely nonspecific and will kill your cherished plants on contact as readily as the things which you want to destroy. Part of the leisure time won by using these weed killers should be spent

in a very careful reading of the label and instructions that come from the maker.

It is only fair to stress how seductive the surface mulch method of gardening is. I grew up trenching and double-digging ground for vegetable and flower beds, getting a good deal of pleasure from the neatly turned soil. Now, I would not dream of using a spade for anything but planting trees and shrubs, and my ground is never turned over. My neighbors routinely call me when they have raked grass cuttings, prunings or leaves, which I haul back to spread on my garden along with leaves collected from the street gutters on early fall mornings. Once you have burrowed down into a heavy mulch layer to feel the warmth and see all the worm activity there, it is hard to go back to sterile, raked, rubbish-free surfaces for flower beds.

If by now, you are still convinced that you cannot make this change in gardening methods, perhaps you will enjoy the entertaining accounts of those who have: Ruth Stout's *Gardening Without Work* and Jean Hershey's *Carefree Gardening*. Be warned, however, that if you have any weakening at all towards trying the surface mulch method of gardening, their experiences are likely to convince you; and you too may end up with your garden being your compost heap.

NEWSLETTER

A monthly newsletter, *The Garden Today*, is now being published and mailed locally to give information of a more immediate nature: Garden news concerning the fund drive, Friends of the Garden, Tower Grove House, and the monthly calendar. The *Bulletin* will emphasize articles on Garden research, botany, and horticulture for our area.

SNOWDROPS AND SNOWFLAKES

Edgar Denison

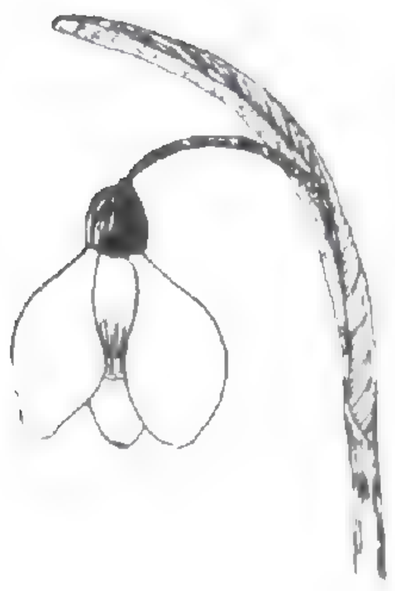
Edgar Denison is an amateur naturalist
and artist of professional ability.

THERE ARE A FEW precious plants which by their sheer audacity seem to entice spring to make an appearance. They challenge cold and snow and persist against the odds of freezing temperatures. Two are shrubs, witchhazel and wintergreen; one is an herbaceous plant, the Christmas rose *(Helleborus niger)*, and one is a tiny bulbous iris *(Iris Danfordii)*. A few are crocus species; another small bulb is winter aconite and, last but not least, there are the snowdrops and snowflakes.

These notes deal with two kinds of snowdrops and two of snowflakes. Three of the four bloom very early in spring, and the fourth in April and May. All are bulbous plants belonging to the amaryllis family. The early ones are *Galanthus nivalis, Galanthus Elwesii,* and *Leucojum vernum,* and the later-blooming *Leucojum* is *L. aestivale.*

The earliest snowdrop is *Galanthus Elwesii.* It is almost incredible what abuse by icy weather this and the somewhat later *Galanthus nivalis* will stand—they seem indestructible. The *Galanthus* flower is quite deceiving. Three more or less spreading petals surround what looks like a tube, but closer examination shows that there is no tube but three separate additional petals, which have only a tube-like appearance, and which are splotched with green areas. *G. Elwesii* blooms about two weeks ahead of *G. nivalis,* is larger, and has bigger, more rounded outer petals. Both species produce just one flower on each stalk.

Galanthus nivalis



Galanthus Elwesii

Galanthus nivalis
Flore Pleno

Leucojum vernum has a bell-shaped flower with all six petals of equal size. The German name *Schneegloeckchen*, little snow bell, fits it to perfection. To avoid retributions by General De Gaulle let us hasten to mention the charming French name, *Perce Neige*, snow-piercer. It is always surprising to see them push through the surface and produce a lovely bell-flower, when barely 2½ or 3 inches high. But the same flower will hang from a stem grown to 9 inches high two weeks later without any sign of wilting—though an entirely different picture. *Leucojum vernum* has one problem even more acute than in *Galanthus nivalis;* it resents being dug up and shipped. In fact, it cannot be shipped like most other bulbs without complete loss of vigor. I believe that they could be air-freighted, packed in moist soil, but that would be expensive and is not done. Thus, *Leucojum vernum* must be grown from seed which, fortunately, is not difficult.

The early flowering snowdrops and snowflakes like a humus-rich soil, ideally, a soil enriched liberally with leafmold. We plant the bulbs about 2½ to 3 inches deep and each fall cover them with around 3 inches of leafmold. The leafmold culture insures an insulating blanket in winter and an excellent seed bed in late spring. Snowdrops self-seed readily, almost eagerly. Essential to seed formation is the presence of bees who work frantically on these earliest flowers whenever the thermometer climbs into the fifties. *Leucojum vernum* will also self-seed, but it is better to gather the seeds before they fall and start them under controlled conditions, that is, in a flat or in a coldframe. Seeds must be planted immediately since they dry out quite fast and lose their vitality.

Both *Galanthus* species form new bulbs in humus-rich soil and do this quite generously, so that an occasional dividing becomes

Leucojum vernum

Leucojum aestivale

necessary. There is some controversy when dividing should be done. The best authority in Great Britain says they should be divided when in full bloom. Experience in St. Louis indicates that this somewhat gruesome procedure is entirely unnecessary and division can be accomplished just as well when the bulbs have become dormant in late spring or early summer. A complete fertilizer is broadcast in early fall and again in February—always on the last (?) snow. No scientific dosing is attempted.

Remember: A bulb out of the ground, especially a small bulb, is not unlike a fish out of water. Keep them (the bulbs not the fish) in the moist, but not wet, soil even while transplanting them in your own garden. Snowdrops and, much more so, snowflakes, resent drying.

Under St. Louis weather conditions, the early snowdrops and the snowflakes prefer light shade, that is, a place under trees which are bare in early spring but provide shade in the summer. Watering during dry periods in summer is recommended.

Lest a true snowdrop lover be misled, there are many more species and varieties of *Galanthus* besides *Elwesii* and *nivalis*. Bailey lists 20 in his encyclopedia. The charming but difficult double snowdrop is a little jewel and may be worth trying. Many are not hardy in our climate, and others differ little from the two species described here. These minor and insignificant variants can only be appreciated if the flowers are picked or by lying patiently observing on the ground, which is normally wet in spring. A drift of snowdrops is a delight to the eye and, given the proper situation, they will be there every spring. That is more than we can say of many other bulbs.

Very different from the early *L. vernum* is the *L. aestivale* which blooms in the middle of spring. It has large dark bulbs which are almost indistinguishable from large *Narcissus* bulbs. It grows to two feet tall, forms large clumps, thrives in any good garden soil in sun or partial shade and, in contrast to all other spring flowering bulbs, retains the dark green foliage until early fall. The leaves are very much like those of *Narcissus*. *L. aestivale* forms new bulbs at almost incredible speed, and after a few years (how many depends on soil and fertility) must be divided either into smaller clumps or individual bulbs. It is not uncommon to get 50 bulbs from one clump after only four years from planting one bulb. Unlike the early snow drops and snowflakes, the summer snowflake carries from four to six or even more flowers on one stalk. Flower arrangers esteem their gracefulness and use them in Japanese line arrangements. Needless to say, the foliage must be permitted to ripen and should not be knotted into horsetail braids, an atrocity committed by many with innocent *Narcissus*. Bulbs sold commercially will present considerable variety of size of flowers and height of growth, with a range from one to two feet. The plants are very hardy but do appreciate an occasional application of a complete fertilizer.

Animal Research at the Garden

Warren Porter

Dr. Porter, a native of Illinois, received his doctorate in zoology from U.C.L.A. Now teaching at the University of Wisconsin, he was in residence at the Garden last year as a post-doctoral research associate working with Dr. Gates in ecology. His research was supported by the Center for the Biology of Natural Systems at Washington University.

STUDENTS AND STAFF struggle with half-grown wolves and foxes on the grounds of the Missouri Botanical Garden. Young men carrying space-age equipment scramble over, through, and into hog and cattle pens in our local stockyards. This would seem to be strange business for a botanical garden, but these unusual goings-on are part of the expanding ecological research program at the Missouri Botanical Garden.

Ecology has been a rather inexact science until recently. Biologists have had vague notions of the manner of interaction between a plant or animal and its surroundings. But they did not have a quantitative means of evaluating environmental relationships.

What has been needed is a comprehensive study of the simultaneous influence of all the physical aspects of environment upon a plant or animal. Heat radiation from both the sun and nearby objects, wind speed, air temperature, and humidity all act to either heat or cool the surfaces of living things. Certain features of living things, such as size, color, fur and fat thickness, also affect their surface temperature. Water loss by sweating and breathing cool an animal by evaporation. Metabolism of food warms an animal.

Claude Johnston

Dr. Warren Porter and Dr. David Gates discuss their ecology projects near the Experimental Greenhouse.

For the past two years, Dr. Gates and I have been doing theo-
etical and experimental research on this energy exchange between
nimals and their environment. Our aim is to determine the relative
nportance of each of the parts of the environment to many differ-
nt sizes of animals. With the help of a large computer at Washington
niversity, we have been putting together all possible combinations
f the environmental and animal properties that I have mentioned.

We are now able to predict surface and body (core) tempera-
ures for many animals in many different environments. With this
formation plus geographical data, we can predict the environmental
mits of specific animals. We can tell whether a cardinal, a shrew,
r a sheep will be able to live successfully in a given location.

From a model based on the essentially cylindrical shape of most
nimals, we derived an equation to describe the transfer of energy
and from an animal's surface, using the environmental factors
f radiation, wind speed, and air temperature, as well as the animal
roperties of metabolism, evaporation, fur and fat thickness. For
mplicity we assumed that the animal model was in equilibrium with
s environment, that is, the net energy flow into and out of the
nimal would equal zero.

At this point we were able to take advantage of the computer
Washington University. Using our animal energy budget equation,
e asked the computer what the surface temperature would be for
very combination of environment and animal properties. Now why
the surface temperature so important? The surface temperature
the key to the exchange of energy between an animal and its
nvironment. If the surface temperature is higher than the relatively
onstant core or body temperature, then heat is going to move from
ne surface to the core and the animal will begin to heat up. This
ould be what we call heat stress. If, on the other hand, the surface
mperature is lower than the core temperature, then the animal is
oing to lose heat to the environment. We might describe losing heat
s cold stress.

One of the most significant findings of our study has been the
ealization of the tremendous importance of the size or the diameter
f the object or animal. For example, small objects such as a grass-
opper are profoundly influenced by air temperature and wind
peed. When the wind blows, and if the air temperature is markedly
ooler than that of the animals, there may be a temperature drop
f 10 or 20 degrees at its surface. Radiation, on the other hand, does

Claude John

The author working with a spectrophotometer, which measures reflected and tra mitted radiant energy of any material.

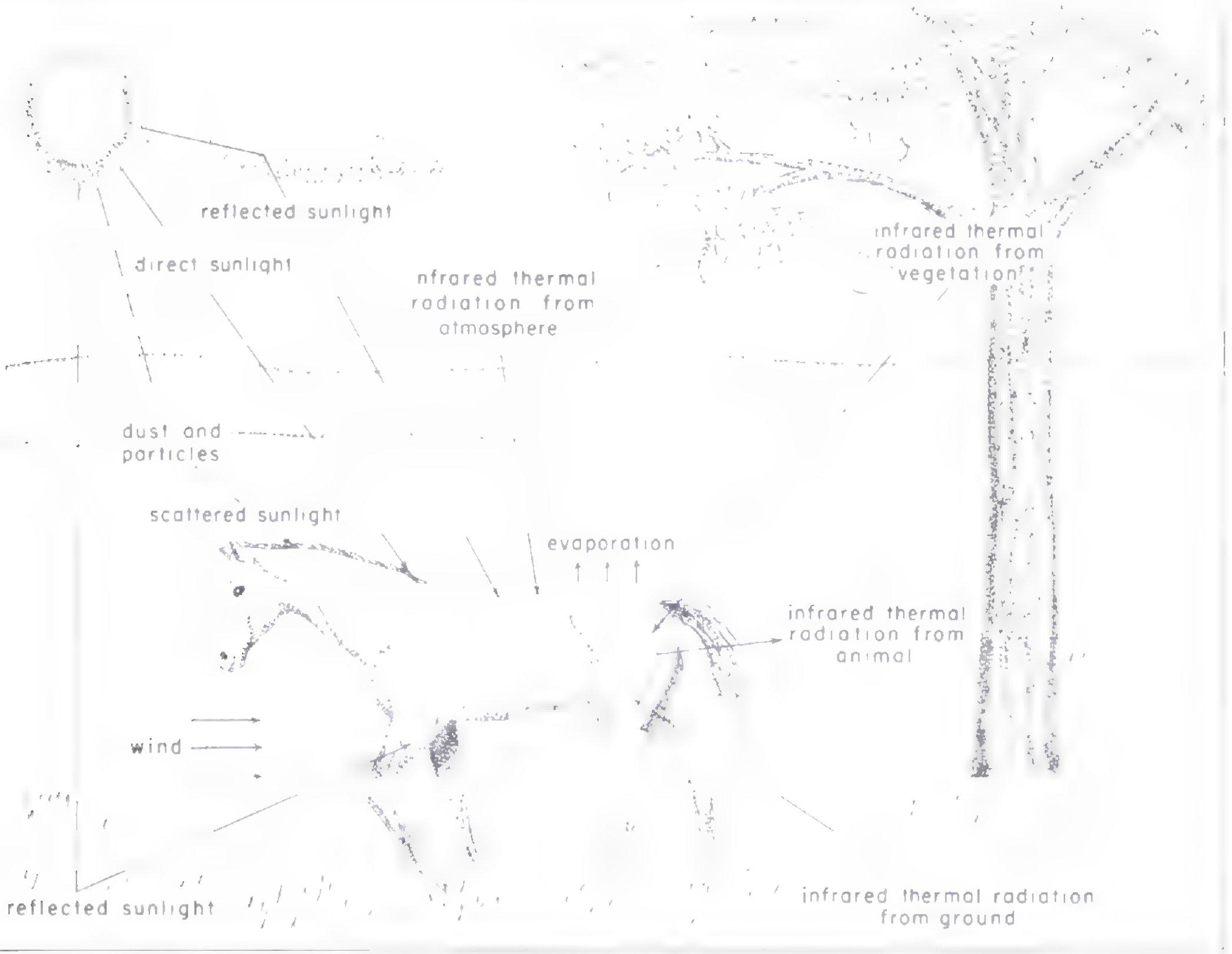
not have much influence on small animals. A large object, howeve like a pig or cow, is greatly affected by radiation but not so muc by air temperature or wind speed.

The reason for this intriguing phenomenon is that around a objects there is a layer of relatively still air next to the surface whic is called the boundary layer. This boundary layer surrounds all ob jects because of friction between the air and the object's surfac The thickness of the layer depends on the size of the object: Ther will be more friction or "drag" in the case of a large surface area an therefore the boundary layer will be thicker. The reverse is als true. Thus, at low wind speeds, the grasshopper may have a boundar layer only about 1/10th inch thick; whereas the pig or cow ma have a boundary layer of 1½ inches in thickness. The harder th wind blows, the more it sweeps away this layer of insulating ai In a strong wind, very little of the boundary layer remains aroun the small animal, but the larger animals are left with a thicker laye That is why wind and air temperature cannot have nearly as muc of a cooling or heating effect on large animals.

We tested the computer predictions with experiments in th Experimental Greenhouse basement. A wind tunnel in combinatio with an overhead bank of lights made it possible to vary the environ

nental factors. At first we used several stuffed animals, both because ney are easier to manage and because we didn't have the worrisome omplications of metabolism and evaporative water loss. We were elighted to find that our computer-predicted surface temperatures losely matched the actual measured surface temperatures.

Since the experimental work with the wind tunnel was so successful, we have been doing some preliminary experiments with ve animals. I mentioned earlier that the amount of radiation absorbed is very important in determining the surface temperature f large animals. Color determines how much radiation is absorbed rom the sun. A large object like a Hereford steer with a white and ed hide should have different temperatures on the white than on ne red part of the hide, which absorbs more of the sun's energy. o test this, we went to the stockyards and measured surface temeratures of steers under a mid-day sun and found that the white arts of the fur were almost 20° Fahrenheit cooler than the red parts f the fur, even though the two were immediately adjacent to each ther.



Streams of energy between an animal and the environment

Barbara Law

Warren Porter and crew checking the temperatures of the hog trucks and pens the East St. Louis stockyards. He is using the radiometer, a portable surfa thermometer that has the advantage of being able to read the temperature of a view surface at any distance without actually touching that surface.

While at the stockyards, we met Howard White, who is associate with the firm of St. Louis Order Buyers. He has been having a grea deal of trouble losing hogs in the summer hot spells. After talking t us and finding out what we were doing, he wanted to know how h could improve the environment of his hogs to keep some of the from dying of heat exhaustion, either in the stockyards or on the way to packing houses. In the middle of the day the hogs are move from the auction pens to the railroad cars or trucks which transpo them to slaughter houses. They must walk from the pens to the ca or trucks on brick walks exposed to the full sun. We measured th brick surface temperatures and found that they were 140° Fahrenhei At such high temperatures the heat energy radiating from the brick is almost as great as the radiation from the sun overhead. Ou measurements of the hogs' surface temperatures under such condition confirmed our predictions that the animals were under tremendou stress.

The idle railroad cars and trucks waiting in the sun to transpo the hogs also had inside roof temperatures of 140° Fahrenheit. Afte entering the cars and trucks, the hogs again are under an enormou thermal radiation load. We pointed out to Mr. White that if th walks, the trucks, and the railroad cars could be shaded or covere in some way, he could drop their temperatures by at least 20° an thereby reduce the radiation load on his hogs. Also, if the railroa car roofs were insulated, the heat load on the animals could agai

be greatly reduced. The rate of hog survival should then be much higher. An additional solution that Mr. White is now using is an effective and simple one: He cools the hogs by spraying them with water and cools the large stock trucks by spraying the metal roofs before loading the hogs. Evaporative cooling lowers the hog surface temperatures by at least 10°F. and reduces the truck temperature by 45°F.

The importance of radiation to large objects revealed by our energy budget studies also applies to dairy cattle. In the summertime, milk production often may fall off in hot spells if dairy cows are not provided with shade in order for them to escape radiation which heats their surface temperatures to high levels.

If the surface temperature of cows starts to rise, they must sweat, i.e. lose water, to keep their surface temperature cool. If, however, the surface temperature can be kept cool by shading, i.e. reducing the radiation load, then the water which is normally used for evaporative cooling could be used instead for increased milk production.

These are some of the possible practical uses of the study which Dr. Gates and I have been doing. On a more abstract level, we are interested in being able to predict accurately the environmental limits for different sorts of animals. For example, why are penguins able to live in the areas they do and why are they obviously too hot in summer time in Antarctica, even though the air temperature is at the freezing point of water? With our energy budget equation we are beginning to be able to show in a quantitative manner why and how and when penguins will go into heat stress and when they will be comfortable or easily able to cope with the environment in which they exist. We're hoping to do the same sort of thing with many different kinds of animals. Currently, we are working out detailed analyses of specific animals, trying to identify specific environments in which they can and cannot survive.

As familiar as the word ecology has come to be, it is pretty safe to say that most people do not associate it with their "daily bread." They find it difficult to imagine that the lofty-sounding phrase, biophysical ecology, could have much to do with anything as practical as saving hogs from death due to heat exhaustion or increasing milk production in dairy cattle. In animal research at the Garden, our study of the relationship of living things and their environment, we are demonstrating that pure research can have a lot to do with everyday living.

SHAPING DWARFED TREES

Ann Kimball Pipe

Mrs. Pipe is well-known for her skills in the art of *bonsai*. She has written a book and many articles on the subject. Her *bonsai* collection includes over 400 trees.

THE GROWING of *bonsai*—dwarfed, potted trees—offers one important bonus that the growing of other plants does not. Since a branch, trained to grow in a certain way this year, will hold that shape for the life of the tree, *bonsai* is an "antidote to impermanence" as a sculptor once expressed his feelings about his own work in stone.

Just as a painting will reflect the personality and taste of the artist, the shaping of *bonsai* is a personal thing. If one is inclined to follow rules, there are traditional rules to be followed. If one is not, he may experiment as he wishes, and the appearance of his *bonsai* will improve as his self-education and taste improve.

There is not space here to describe how to grow *bonsai*. Basically they need much the same treatment as any other potted plant. But there are also differences, the most important of which is that most dwarfed trees, like their full-sized counterparts, should live outdoors. This is not a major obstacle, however, and *bonsai* can stand much more abuse than the uninitiated are sometimes led to believe.

The following pictures disprove another misconception—that one must be very young to start a *bonsai* collection of his own. None of the trees shown is fully trained, but all illustrate what can be accomplished in a few years, or, in one example, in a few hours.

Since early spring is the best season for trimming roots and transplanting, now is the time to learn the basic principles of growing trees in pots (there are excellent books available) and for starting a few *bonsai*. While it is not safe to promise there will be no casualties, it is quite safe to predict there will be no regrets.

©Ann Kimball Pipe, 1969

COTONEASTER trained 4 years. About 20 years old when started. (1) Cotoneasters do not transplant easily, and there is greater risk in moving a mature plant of any species than a young one. Because of this double handicap, plant was given plenty of room in which to recover from shock. (2) Eight months later. Tree has leafed out and crucial period is over. (3) Another year. Tree has now been safely moved to final pot. Heavy root at base has been taken off and tree slanted forward to a more graceful position. (4) Two more years. Branches have lengthened, tree is becoming neat and shapely.

This tree requires very little trimming. To encourage its weeping habit, long shoots are never cut back. Only an occasional stray, unruly shoot at the top is removed.

Most species of cotoneasters, especially those with small leaves, make excellent *bonsai*. A well-established plant will be covered with flowers in spring, and have black or red berries in fall.

1

2

3

4

2

3

4

CEDAR trained 2½ years. As it is with most *bonsai* stock, one particularly good feature will make a tree worth developing. In this case it was the contorted species; branches were naturally twisted. (1) Moved to its first pot the day it was purchased. (2) Two months later tentative pruning begun. This tree, with its many branches, would have been developed differently by different growers. One removed branch often suggests the next step. (3) One year later shape is beginning to form. Now in its final, smaller pot, tree is centered correctly but earth is still mounded too high. (4) Another year. Tree has been repotted to level the soil surface. Now that general shape has been established, major work ahead will consist of developing bushiness and clean lines.

Cedars normally put out new growth at branch ends twice a year. It is therefore not difficult to keep them in shape. They are only semi-hardy in this area, however, and must be protected in winter.

Pipe

AZALEA trained 2½ years. A 30-year-old bush was dug d divided to make the start of is *bonsai*.

(1) First potted in April in pure at moss. (2) One month later ight has been reduced. New owth shows it has survived the ock of rather drastic treatment.) The following spring clusters e beginning to take shape. unk sections between have been eaned of growth in order to ve more pleasing form and ntrast. (4) Sixteen months later ant now gives promise of be- ming a very attractive *bonsai*.

Azaleas should be trimmed, aped, and (when necessary) potted in spring, as soon as ooms fade. Since buds for oom the following spring form branch tips during summer onths, very little pruning should done after new leaves appear. zalea branches, unlike those some other plants, may be ortened drastically. New owth will soon appear along ems where no buds were pparent.

2

3

4

1

2

3

4

YEW trained 3 years. (
Found in a local nurser
it had only a wide, tapering tru
to recommend it. Solid folia
mass was unattractive, root b
much too large for easy ha
dling. (2) One month later. Mov
to a large pot, it is beginning
take shape. Foliage has be
thinned, branches wired and ti
downward and outward. (3) Tw
more years. Now in its fin
smaller pot, more trimming a
thinning has been done. The
are still top branches and folia
masses to be studied and i
proved. (4) The next year, reduc
to a single trunk. Effect is no
more pleasing.

As new growth appears,
will be pinched back to indu
thick clumps and eliminate ra
ged appearance of branches. Ne
growth will also suggest furth
changes in shaping.

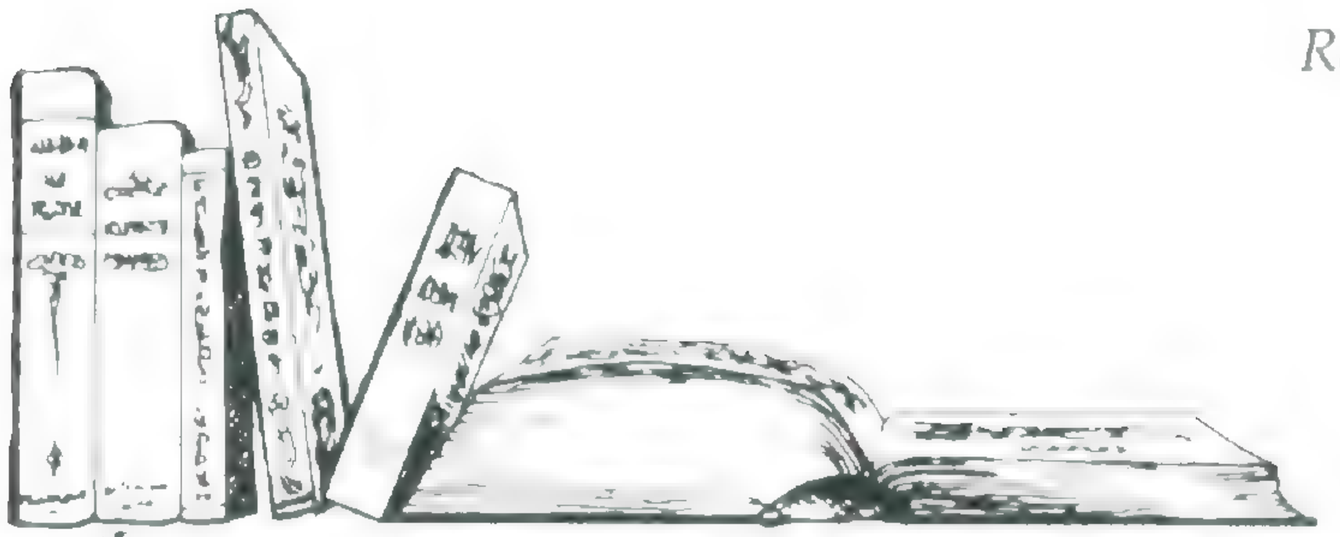
Because original, root-packe
soil ball was so large (and grow
impatient), all soil was hosed o
and tree potted bare-roo
A safer method—leave roots
base of trunk undisturbed ar
cut away only outside edges
ball. Done in yearly stages, pla
can then be moved to successive
smaller pots.

UNIPER, example of "Instant
Bonsai." (1) Although junipers
ansplant easily, plant was
rchased in heat of July, so it
as slipped, undisturbed, from
gallon container into pot of
me size. (2) Tentative trimming
gins. Height has been reduced
d work of thinning starts. (3)
with nearly all *bonsai* stock,
s plant could have been de-
loped in many ways. Here, all
t a few branches were cut
vay. Now each branch is being
red separately. Trunk has been
aked to encourage straight
owth. (4) Wired branches are
nt at right angles to trunk.
tres and stake will be removed
hen new shape becomes per-
anent. (5) Three months later.
ots have now been trimmed
avily and tree moved to
all pot.

'Instant *Bonsai*" is a mis-
mer, of course. This plant has
en shaped in hours, but only
ne and continued control of
w growth will develop a truly
arfed tree. The pictures do
ow, however, that even a very
ung tree can be given the
pearance of an old one, and
t growing *bonsai* can be en-
ed from the day it is begun.

BOOK CORNER

Reviews by Nancy Chute



Mrs. Chute is a volunteer and Friend of the Garden

JAPANESE GARDENS AND FLORAL ART
by Mrs. Paul Kincaid *(Hearthside)*

MINIATURE TREES IN THE JAPANESE STYLE
by Gillian E. Severn *(Taplinger)*

DON'T BE FOOLED by the innocence of the title and the du
jacket photograph of its author, who is pictured swathed
Japanese finery and reverently contemplating a bit of her *ikeban*
Japanese Garden and Floral Art by Mrs. Paul Kincaid (Hearthsi
Press, 1966) is really a book on Japanese culture, and a thorough
rewarding one. This is not a book to whip through (in truth h
prose is a bit involved for speed-reading), but one to keep f
reference and to mull over again and again.

Before launching into her subject matter she introduces us
Japanese history and asethetics because, she explains, "The Japane
aesthetic sensibility rises to such a high level of refinement that th
arts are replete with beauties often too subtle for casual Occident
perception." She emphasizes the point that Japanese gardens a
flower arrangements are arts used to express highest truths of religi
and philosophy, whereas other civilizations have used literatu

painting, ritual dance and music. "To the Japanese mind a garden is not only a place to cultivate trees and plants but a spot that provides simple relaxed and sentimental pleasure, seclusion, leisure, rest and meditation."

Each subject is covered in serious detail, with definitions of terms and references to the cultural background. As well as *ikebana* (flower arranging), gardens and houses, we study the tea cult, Zen philosophy, and the miniature arts of *bonkei* and *bonseki* (tray landscapes) and *bonsai*. Throughout are ways the American can incorporate the Japanese into his house or garden. "More participation in the gentle arts of flowers, gardens, and tea can ease the hurry and worry of our machine and space age and help us achieve a serene mind and calm spirit."

She closes with advice for the visitor to Japan, offering insights into customs and an etiquette so vastly different from our own.

Gillian E. Severn's matter-of-fact presentation makes her book, *Miniature Trees in the Japanese Style* (Taplinger, 1968), easier going than Mrs. Kincaid's. But, as she explains right away, it is not her intention to delve into history and art. Rather, she offers a simple and practical guide for those wishing to make a start, using locally available materials and only those Japanese methods which adapt to our life without incongruity. At this point it becomes apparent that our author is indeed British and that her references to local items like kipper or sultana boxes and John Innes Seed Compost will cause us a certain amount of cultural adjustment, too.

"*Bonsai* are in fact, pot-grown miniature replicas of their natural counterparts in the wild . . . The object of all the care and effort in *bonsai* culture is to dwarf the stem, shoots and leaves of each specimen in order to achieve, finally, a well-proportioned miniature." Tender souls will be relieved to learn that these little trees are not starved to keep them small, but are carefully fed and watered. They require much loving care and make wonderful pot plants for the house and on the terrace.

Sketches and photographs are used generously to illustrate the different *bonsai* classifications and their wiring and training techniques, as well as to make clearer the wheres and whys of pruning and pinching—always moments of indecision for beginners. One section covers starting plants from seeds, seedlings or cuttings, and

there are others on containers, soil, manuring, likely diseases, etc., and the mini-*bonsai* called *mame* which are only two to eight inches tall. For each type of *bonsai* from cascading to clasped-to-stone, she offers a descriptive list of suitable plants and cross-references everything with a fine index at the end.

Here then are two recent books on Japanese gardening designed to reach both devotees and those of us newly attracted to a further study of this subtle culture. Each author offers a different approach. In Mrs. Kincaid's book we find an in-depth coverage of all aspects, with the emphasis on understanding the Japanese philosophy behind the art form. Mrs. Severn concentrates on a practical application of one form, *bonsai*, so that by working with these miniature trees we acquire a feeling for the underlying philosophy. Either way, its invigorating.

The Partnership of Hollies and Birds

There is a natural relationship between spiny or thorny evergreens such as a red cedar or a holly and the small birds that roost in their branches during cold winter nights. The birds have shelter from the cold and protection from hawks and owls. The evergreens have the advantage of the bird droppings which wash off with the snows and rains and fertilize the tree. Hollies in particular are strong feeders; they grow their best in very rich soil. By scattering bird seed at the base of holly bushes one encourages bird visitors and indirectly brings the hollies the fertilizer which is best for them.

E.A.

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Visit Your Missouri Botanical Garden

(SHAW'S GARDEN)

The Missouri Botanical Garden's main entrance is at Tower Grove and Flora Place. The Garden is served by both the Sarah (No. 42) and the Southampton (No. 80) city bus lines.

The Missouri Botanical Garden Arboretum—1600 acres—established at Gray Summit, Missouri, in 1926, is open to the public.

The Garden—70 acres—is open every day except Christmas and New Year's. For the main entrance, grounds, Climatron, display greenhouses, and Floral Display House:

May 1 through October 31 . . . . 9:00 a.m. to 6:00 p.m.
November 1 through April 30 9:00 a.m. to 5:00 p.m.
Sundays and Holidays . . . . . 9:00 a.m. to 7:00 p.m.

For Tower Grove House:

May 1 through October 31 . . . . 9:00 a.m. to 5:00 p.m.
November 1 through April 30 10:00 a.m. to 4:00 p.m.

The Display House presents four major shows: November, Chrysanthemums; December, Poinsettias; February, Orchids; April, Spring Flower Show. During the year other shows, competitions, and festivals are sponsored by various garden clubs and flower societies.

Courses in botany and horticulture for adults are conducted by the Garden staff. Children's nature classes are provided free on Saturdays from mid-September to early June. The Pitzman Nature Program is held for children during the summer. The Garden is world famous for its scientific research program. The scientists of the Garden hold teaching appointments on the staff of Washington University.

The Missouri Botanical Garden was established for the public's benefit in 1859 by Henry Shaw. The Garden, a non-profit institution, relies for support solely upon contributions from the public, the Arts and Education Council, and income from the Shaw estate. The Garden receives no city or state tax support.

Support your Garden and take part in Garden activities through the Friends of the Garden. Information may be obtained from the Main Gate or by mail or phone (865-0440).

MISSOURI BOTANICAL GARDEN

BULLETIN

VOLUME LVII NO. 3

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From the Director

I WISH EACH of you could stop at the Garden to see for yourself the excitement of the young children in the Saturday nature classes and on the school field trips. Or better yet, you could come by during the summer Pitzman Nature Program when hundreds of youngsters are chasing butterflies, pressing leaves, or in various ways experiencing the diversity and beauty of nature as found within the bounds of this great botanical garden. For many of these children whose young lives are spent almost entirely in the paved desert of the city this will be their first encounter with natural history. Children achieve an appreciation for the living world from these courses at the Garden which will help them as adults for decades to come.

The Missouri Botanical Garden tells the story of plants to the hundreds of annual visitors who pass through its gates. This is an unusual opportunity both for us and for those who visit here. More than a park or just a showplace, the Garden is a great center of culture and learning. Because of our splendid staff, great scientific collections, fabulous library, and extensive grounds, arboretum, and greenhouses, we can inform the public about plants and natural history to an unusual degree.

But we must have your help. We need classrooms for the children's programs; we need a small auditorium in which the public can hear and see the great achievements of botany and natural history; we need a safe, clean, air conditioned building for our preserved plants and great books; and we need a strong financial base for future operations.

Have the personal satisfaction of helping the Garden make a better world through learning and education. Send your contribution today to:

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Thank you,
David M. Gates

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Cover design by Peter Geist.
Illustration is from a woodcut of the herb oregano *(Origanum vulgare)* in the *Latin Herbarius* printed by Peter Schöffer in Mainz in 1484.

GARDENING IN ST. LOUIS

MAY-JUNE

ST. LOUIS' MOST glorious season, spring, is the time of year when gardeners' ambitions often surpass their later hot-weather capabilities. Planning the season's plantings in scale on paper will help keep things within reasonable bounds and also help the gardener view his yard as a whole rather than as a disjointed sum of little plots.

Mulching, weeding, spraying, dusting, and fertilizing programs should be followed consistently. It's too easy to get behind during the spring burst of growth and bloom.

Clip back spring bulb foliage when all signs of green are gone. Flowering shrubs may be pruned after their blooming season is past.

May is the month to set out tomato plants. The dwarf, small-fruited varieties are attractive planted in tubs or pots and used as accents around the patio or in a flower garden. The same is true for that handsome vegetable garden favorite, the green pepper. Make sure they get a lot of sun and sufficient water. A little bone meal or fertilizer (5-10-5) in each tub or pot will take care of the food requirements.

Bare spots in areas with ground cover, such as ajuga, myrtle, ivy, and pachysandra can be filled in by pulling healthy young runners out to the spot and layering them; that is, covering the runner with tamped soil to promote new root development.

Get those broad-leaved weeds by applying 2, 4-D when the weather promises to be above 70° for several hours, but watch out for spray drift of volatile chemicals.

Flats of annual flowers are a quick way to color in your garden. Buy only the healthiest stock of area-proven varieties. A border of leaf lettuce, carrots, or even radishes will enhance the flower garden and give added zest to summer salads.

Occasional heavy waterings (not daily sprinkling) will help newly planted trees and shrubs and will also encourage annuals to make the extensive root system that will be valuable through the summer.

THE HORSECHESTNUT

Aesculus Hippocastanum

Edgar Anderson

WHEN IN FULL bloom a horsechestnut is one of the loveliest of the world's flowering trees. It is not related to the true chestnut, and the nuts are not edible. The individual flowers are small but are fluted and ruffled with a nicety that gives them the quality of an orchid. This is enhanced by spots of yellow which deepen to pink before the flower passes so that yellow-spotted and pink-spotted blossoms are massed in upright pyramidal clusters about two feet high, often referred to as candelabra.

Horsechestnuts are technically a European tree but come from such a remote back corner that they were unknown over most of Europe until very late. Eventually they came into the hands of the Turks and were planted at Constantinople. In 1576, seeds were sent to Vienna for the Emperor's new botanical garden, whose director, l'Ecluse (known to scholars as Clusius), was an old hand at getting plants talked about and sent around. By 1633 they were listed as growing in an English garden. The horsechestnut has been much planted in France and England and the low countries where it is at its best, as in the aristocratic outer suburbs of Brussels.

Aside from this one European species, the genus *Aesculus* is native to Japan, to China, to northern India, to the eastern and central United States, and to California. There are probably 20 or more species in all, just how many is hard to say for they hybridize readily,

Hugh McCaffrey

This fine horsechestnut is located just south of the Museum Building on the grounds of the Missouri Botanical Garden.

producing variants which one authority will call a variety but others may catalogue as a separate species. They are all woody, many of them large shrubs or small trees. Most of the American species are called "buckeyes," an excellent name for those with spherical seeds. The nut looks like the glistening eye of a deer.

In Missouri, the extremes of our native buckeyes are the red buckeye *(Aesculus discolor)*, a shrub with bright red flowers native to southeastern Missouri swamplands, and the Ohio buckeye (with greenish flowers) found in parts of the Ozarks. Most of Missouri's buckeyes are in one way or another intermediate between these extremes and are classified as varieties of *A. glabra* or *A. discolor*. Near Times Beach, west of St. Louis, they are native to the valley of Antire Creek. They grow just above the creek bed, no two of them alike, most of them vigorous large shrubs with yellowish green flowers, varying greatly in the intensity of the pink or reddish pigment and in what part of the flower it is brightest.

Horsechestnuts have done well in the smokiest part of London. During those decades when the Missouri Botanical Garden was practically in the industrial zone of heavy smoke, our old specimens continued to grow and to blossom. In some summers here the leaves are more or less yellowed or even scorched. Watching the trees through a good many summers, knowing at first hand the Balkan mountain climates from which they came, I have wondered if, like myself, they really do not greatly mind the hot days (they had those in the Balkans) but find the hot nights difficult. As our former Director Dr. Frits Went has shown, night temperatures are important levers in the control of a plant. Most trees do best when given night temperatures similar to those of their homelands.

Both buckeyes and horsechestnuts are potentially poisonous, though precise evidence is scattered and somewhat conflicting. Children and farm animals have been poisoned by eating the nuts or the leaves of new shoots, but careful feeding experiments with animals produced symptoms of poisoning in some but not all of the animals under observation.

Horsechestnuts get their common name from the shape of the large scar made on the twig when the leaves fall. They are the shape of a horse's hoof seen from below. The veins running out from the twig to the leaflets make little dot-like scars, looking enough like horseshoe nails to increase the resemblance.

The distinctive leaves and fruit of the horsechestnut tree *(Aesculus hippocastanum).*

The leaves of the horsechestnut are distinctive. As a whole, each is a flat symmetrical hand. On the largest leaves it has five big leafy fingers and little leafy thumbs on either side. The fingers next to the thumbs, transitional to them in size and shape, give the composition unity and balance. If these two leaflets are removed, the leaf still looks complete but its peculiar charm is gone.

There are enough horsechestnuts at the Garden to make a good demonstration of the effects of age and site on this species. Along the walk between the Climatron and the Floral Display House is a middle-aged specimen so heavily shaded that it no longer flowers freely. In the mausoleum grove there is a fine old tree whose flowers

are almost exclusively on the sunnier upper branches. In many autumns it colors attractively and makes an effective background for Mr. Shaw's mausoleum.

Between the mausoleum grounds and the new Lehmann rose garden is the most picturesque of the Garden's horsechestnuts. It has several trunks and though they are now grown together below, one can see that they were originally separate practically to the ground level. Long ago, the top was blown out of this tree, and it was cut back almost to the ground. Big scars on the various trunks show where it was repeatedly repaired after other accidents. South of the Museum is a fairly mature tree that seems to have developed the habit of alternate flowering, a common tendency in various kinds of flowering trees. This tree flowered abundantly in 1961, '63, '65, '67; and in the alternate years flowered increasingly lightly, bearing fewer and fewer nuts.

Between the Museum and the Main Gate, standing out in the open by itself, is a small horsechestnut with short branches and wide dark-green leaves. It is the double-flowered variety *(A. hippocastanum* var. *baumannii),* so full of petals as to give somewhat the effect of coconut frosting. It is of scientific interest because its exact history is known. It is a typical example of a true "bud sport." Many years ago a normal tree in the garden of M. Duval in Geneva, Switzerland, put out one branch which bore strangely contorted leaves. It was carefully watched; when it bloomed the flowers were all double. From this one branch came the double-flowered horsechestnuts all over the world. They never set fruit and must be grafted.

Ordinary horsechestnuts set fruit readily. At best the panicles resemble miniature artificial Xmas trees hung with green ornaments. Most of these fall in a few days, leaving a strange harvest on the grass. The few that remain on the tree continue to expand. By the end of summer the fruits are smooth green globes set with blunt spines. They ripen about September and crack open, scattering the nuts if the impatient squirrels do not gnaw them off the tree first. As they ripen, they become more attractive each year to squirrels, children, and arthritic adults who follow the old folk belief that if you carry a dried horsechestnut around with you "it wards off the rheumatiz."

Squirrels and horsechestnuts must have evolved together. Each helps the other. In his Lockwood Conference lecture, Dr. Frits Went

told with scientific precision how closely the germination of horse-chestnuts is adjusted to squirrel behavior:

"Those seeds have to go through the winter, but you cannot store the seed. If you collect horsechestnuts or acorns and keep them over winter and put them out next year, you have lost all of them. They just don't germinate. You must store them at a rather high humidity. This happens when they have been buried by squirrels or birds. The horsechestnut needs a cold period. That is the reason why you find horsechestnuts germinating in many places if there are areas where squirrels can bury them."

The nuts themselves are among the most intriguing objects in the plant kingdom. Each has a smooth gray-brown scar as large as a thumbnail or larger, where it was attached to the tree. The rest of the nut has a patterned gloss like polished mahogany, though in a few days they begin to shrivel and lose their brilliance.

Each nut has a different shape and a different gloss pattern; they fascinate people of all ages and conditions of life. This can become the doom of the tree that bore them. Adults as well as children pull down the lower branches, frequently breaking them. They whack at the trees with poles or pipes. They boost each other into the trees and the weak branches break off.

In England boys play a simple game called "conkers" (short for conquerers). A nut is threaded on a stout cord by each of two contestants; holding the ends of the cords they strike the nuts violently together with a whip motion until one is dented and its owner forfeits it to the other boy. Mr. G. H. Pring recalls that nuts were sometimes boiled to make them tougher. These toughened ones were usually detected and allowed in play only against others similarly toughened. In the outskirts of London, I have seen boys with school bags bulging with these trophies. I found that English boys (with a kind of grim pride) were nearly as unprincipled as American ones in the ways they gathered horsechestnuts. English authorities, as well as American ones, do not recommend the horsechestnut for sites readily accessible to the general public.

The relationship between Man and plants is a tangled one. Horsechestnuts, planted and cherished by a small minority, savagely attacked by an apparent majority, vulnerable because of their strange beauty, are an example of the dark threads in Man's fabric.

ALONG THE RAILROAD TRACKS

A Study of Adventive Plants

Viktor Muehlenbach

Viktor Muehlenbach, a native of Riga, the capital of Latvia, has a degree in medicine as well as a master's degree in natural sciences. He taught and worked in research at the University of Riga until the Russians took over the country. With his wife, mother, son, and daughter, he escaped to Germany in 1944. After over 5 years in a displaced persons camp, the Muehlenbachs came to the United States in 1951. Dr. Muehlenbach worked as a medical technologist and became supervisor of the mycobacteriology and mycology unit of the Public Health Laboratories of the City of St. Louis until his retirement in 1968.

Dr. Muehlenbach began botanical work at the Garden in his spare time in the winter of 1953-54. He was made a research associate in December, 1956, and since his retirement from the health department, has expanded his adventive plant research at the Garden.

THE INFLUENCE of man on the vegetation of our earth has been overwhelming and continues to increase. His accomplishments are evident in the millions upon millions of acres devoted to agriculture. His unintentional influence on the vegetation is as clearly evident along the roadways, railroads and seaports. For in transporting goods from place to place, seeds or other plant parts suitable for propagation are frequently unintentionally attached to them. Some seeds fall on the ground during transport, especially when unloading goods, and grow under favorable circumstances.

K. Muehlenbach

An adventive plant on its way to the Herbarium of the Missouri Botanical Garden.

Early in the development of railroad systems, botanists were aware that on right-of-ways and especially in freight and switch yards of railroads, plants could be found which certainly were not native, but had been brought in from far away. These were called introduced plants, and very frequently we refer to such plants as adventive or adventitious (from a derivative of the Latin word *advenire*—to come or arrive at a place). Yes, these plants come without invitation, and they are there.

The St. Louis metropolitan area has a railroad network that is second largest in the United States. Therefore, the study of the presence, frequency, and distribution of adventive plants in St. Louis is very rewarding. With the kind permission of the different railroad companies, the author began the study in 1954 and continued until last autumn. It was a continuation of work started by him in his native city, Riga, Latvia, where he had observed the adventive flora of the Riga railroad network for 20 years.

The difficulties of the study in the St. Louis area were overwhelming at the outset. The work had to be done with a flora mostly

unknown to the author. If there had not been support from many distinguished American botanists (including those at the National Herbarium of the Smithsonian Institution) who determined thousands of collected specimens, the work would have been impossible. Much encouragement was given by Dr. Edgar Anderson, Dr. J. A. Steyermark, and Dr. G. B. Van Schaack from the staff of the Missouri Botanical Garden. Dr. Steyermark's *Flora of Missouri* was eminently helpful in distinguishing which plants were native and which adventive. To reduce many difficulties, the study was restricted to the city limits of St. Louis. In the first years, a general acquaintance with this whole railroad network was attempted. Observations taught us that transportation of some cargoes is especially encouraging for the introduction of adventive plants. Agricultural products have first place. Although adventive plants can be met everywhere on railroad territories, the accumulation of adventives is often unexpectedly high in a few limited places. It is almost impossible, however, to predict these places. There are many tracks and sheds where nothing of interest could be found in spite of the fact that traffic with agricultural products on and around them was especially heavy. On the other hand, many rarities or even species not yet known to be in the Missouri flora could be found on another track with minimal traffic a short distance away.

The most recent list of observed adventive plants contains 314 species (with the inclusion of a very few subspecies); 79 were new to Missouri of which 12 species are unpublished. What kinds of plants are they? A small minority are cultivated plants which are found over the whole railroad territory. Almost all cereals are represented, wheat being the most common; barley and Italian millet the rarest. Some representatives of the gourd family and several other cultivated plants such as tomatoes, potatoes, beans, onions, etc., can be encountered.

There seems to be a different cause for the existence of some plants here. A few peach and apple trees growing in some remote parts of right-of-ways and freight yards may get their start from fruit cores thrown out by passers-by. In a few cases the observed plants are garden escapees, such as the notorious Japanese honeysuckle *(Lonicera japonica),* a pernicious weed which strangles the native flora wherever it becomes established. There were instances where this plant had jumped a fence from a private garden neigh-

K. Muehlenbach

A track in the St. Louis Avenue freight yard of the Norfolk and Western Railroad, especially rich with adventive plants. Over a period of time at least seven plants new to the Missouri flora were discovered here.

boring on the railroad right-of-way. Further possible escapees are French marigold *(Tagetes erecta)*, portulaca or rose moss *(Portulaca grandiflora)*, beefsteak plant *(Perilla frutescens)*. In several cases these escapees were found far from any garden in circumstances which indicated introduction by shipping. But the bulk of the adventive plants are weeds, many of which accompany crops in fields. Very many of them are of European origin. Now we need to point out a difference which exists in considering weeds in America and Europe. Most European weeds were not originally native to Europe. They came with the crops which are thought to have originated in the Orient. As this process happened in prehistoric times, botanists of Europe frequently consider these weeds native and propose to call them archaeophytes. Seeds of archaeophytes were found in prehistoric Swiss lake dwellings, in Egyptian pyramids, etc. On the other hand, the same weeds in this country are considered adventive. They have grown on American soil only a few hundred years, and, therefore, their status is indeed different from what it is in Europe. One

circumstance should not be overlooked: Many of these European archaeophytes were probably widespread in Missouri and in the St. Louis area before the construction of the railroads began. They came to the area as hitchhikers on pre-rail transportation cargoes.

In the first years of the study, adventive plants of European origin were far more numerous than those native to America. Step by step, however, the number of American western and southern plants began to grow. Could this mean that the whole introduction pattern had changed during the last fifteen years? No, that would

K. Muehlenbach

A very rare plant—*Centaurea diffusa* Lam. (a species related to the cornflower). It demonstrates in what a dangerous site an adventive plant can settle down.

be a wrong inference. The author mentioned before how forlorn he felt in the beginning of the work. It is understandable with his limited knowledge of native plants that the old acquaintances from Europe were the first on the list. In the course of time, however, as his knowledge of native plants increased and more and more plants were identified by specialists, his eyes could better distinguish small differences which were at first unnoticed. In many genera, which are represented in the native flora, plants were found which seemed to differ more or less from the native ones. Again, specialists were able to confirm the fact that these differences existed because the plants belonged to an introduced species. So, adventive plants were found in such genera as spurge *(Euphorbia)*, croton *(Croton)*, storkbill *(Erodium)*, broom snakeroot *(Gutierrezia)*, and many others. With the cooperation of authorities on certain difficult and critical genera, many hundreds of specimens were collected and identified; such as, amaranth *(Amaranthus)*, goosefoot *(Chenopodium)*, knotweed and smartweed *(Polygonum)*. In all of them, rarities and even novelties of the Missouri flora were found. All of this speaks for the fact that one should know the local flora well before he begins studying the adventive flora of the region.

Another phenomenon is quite striking. Although every summer brings additions to the list, many plants observed in previous years could no longer be found. In the case of plants rarely met, attempts were made to find means of rediscovering them. Hundreds of sketches or maps were made which frequently, but not always, helped find the plants in question. With these maps, checks were made annually to determine whether the plants persisted, disappeared, or re-appeared. In the case of unique plants, to avoid total destruction of the specimen only a branch was taken to help in finding those plants on the next collecting trip.

In spite of many obstacles, it was possible to follow the fate of various adventive plants. Even the observation of a single perennial plant could be quite successful. A very showy prairie coneflower *(Ratibida tagetes)* has been observed since 1961, reappearing each summer in spite of various ill-treatments to which the plant is subjected. Many rare plants re-appeared from time to time, but each year in another place, apparently another introduction. But, as was said, many plants once collected, especially in the first years, have never been seen again.

Both nature and man have played their parts in causing the disappearance of many of these plants. Weeds can be adversely affected by climate: heat, drouth, cold. The seeds may fall in a particular spot which proves hazardous to growth. But man is the greatest enemy of the adventive as well as of the native plants: he abandons freight yards; he erects new buildings; he relocates tracks. The biggest peril of all is the constant and intentional battle of railroad administrators against vegetation in their territories. The use of weed killers in now universal and its effectiveness increases. The observations of early years show that vegetation recovered more quickly than it does today. There are now many places which are bare of almost all plant life throughout the entire growing season.

Several times steps were taken to protect some plants which seemed to be especially interesting. Railroad officials were willing to cooperate by providing covers of one kind or another to such plants, which indeed helped them to survive the weed-killing operations. The author wants to express here his appreciation for such consideration. He also considers it his pleasant duty to mention the kindness and understanding of the railroadmen in the freight yards, who on some occasions were ready unasked, to divert trains and traffic so that the author would not be disturbed or endangered in his work.

Taking into account the many dangers and perils to which vegetation is subjected on railroad right-of-ways, it is not astonishing that so many adventive plants are observed rarely or even only once. Thellung, the Swiss botanist who has done much work on the problems of plant introduction, created a special name for such casual plants—ephemerophytes, deriving it from the name of day flies *(Ephemeridae)*. As these flies appear for a very short time, perhaps a day, and vanish again, so do many adventive plants appear for a single growing season and vanish. It is also clear that many adventive species remained unnoticed and undiscovered during the years of study. For this reason, there is no proof that they have ever been guests for a short time in our railroad areas.

The author thinks again and again about the writer of the first Riga adventive flora—E. Lehmann, who cited the words of a German poet to describe vividly the course of things along railroads. These words are *"Ein ewig Kommen, ein ewig Gehen"* (a perpetual coming, a perpetual going). With these words, the poet was describing one

K. Muehlenbach

A mysterious plant: a small colony observed since 1960, but never in flower. (Baden freight yard of the Missouri-Kansas-Texas Railroad.)

of the peculiarities of a university—its perpetual flow of students, coming and going. This is typical of the adventive plants of the yards. But just as some students will stay in the universities after graduation and rise to professorships, some adventive plants not only stay but also begin to spread and occupy areas where weed killers and other dangers cannot harm them. When climatic circumstances are not too different from those in their home countries and seed production is secured, these plants compete successfully with native vegetation and become naturalized. They are the most important among the adventives; and Thellung gave them the name neophytes.

Among the most common adventive plants found on St. Louis railroad right-of-ways and freight yards are crab grass *(Digitaria sanguinalis)* and summer cypress *(Kochia scoparia)*, also called fire-bush. Running a close third is downy chess *(Bromus tectorum)*, a seasonal plant that plays a large role in early summer vegetation, but always disappears in the second half of the summer. Some other common adventive species are green foxtail *(Setaria viridis)*; rough green amaranth *(Amaranthus retroflexus)* (considered a native plant

to some botanists); shepherd's purse *(Capsella bursa pastoria)*; yellow sweet clover *(Melilotus officinalis)*; field bindweed *(Convolvulus arvensis)*.

And so, in spite of man's unyielding efforts to combat the plants he unintentionally introduces along the railroad right-of-ways, the adventives survive in great variety and abundance. Other plants intentionally introduced by man, nurtured in our botanical gardens, also survive in variety and abundance. Both places are fascinating for studying the relationship between plants and man—the botanical garden and the railroad yards.

The Music of a Scientific Name

Some scientific names are beautiful just in themselves. Take the name of the side-oats grama, the little western grass which grows at the edge of the cliff in the Arboretum at Gray Summit (as it does on so many Western mesas). It was named Boutelous in honor of Claudio Boutelou, a Spaniard who wrote about floriculture. Said several times in quick succession and with a rising inflection, "Bouteloua-Bouteloua-Bouteloua!" it sounds almost as musical as water coming out of a bottle.

E.A.

LAD CUTAK

Patron Saint of Cacti

Barbara Lawton

THESE ARE DANGEROUS plants to work with. I've pulled spines from my body, legs, arms, and even my head. One time when I was working with the blade apple cactus *(Pereskia saccharosa)*, a primitive cactus that has foliage and thorns up to 2" long, I had a ½" thorn go into my eye. It was a miracle that I didn't lose my sight for these thorns come in bunches and are such efficient pins that I use them in holding grafted stock together.

"In spite of this, I love the spiny plants—the spinier the better. They're vicious, but they're fascinating. They are fantastic to see in their natural desert habitat, especially when the light comes from behind them."

So says Ladislaus Cutak who could well be called the patron saint of cacti and succulents. A self-educated man, he has become a leading authority on desert plants. Along with his knowledge and industry, he has brought enthusiasm and cheerful optimism to the Garden.

Lad was born in the heart of Central Europe in May, 1908. His Czech parents lived in Bukovany, a town in Moravia, about one hour north of Vienna. This is very near Brno, where the brilliant Moravian monk, Mendel, worked out his basic studies of inherited characteristics of plants over 100 years ago.

Lad's father, Joseph Cutak, began his horticultural career in the gardens of the famous Schönbrunn Castle in Vienna. An adventuring spirit and the promise of opportunity brought Joseph Cutak to the United States in 1911. His wife's two brothers had immigrated

5 years earlier, one to pioneer in Wisconsin, the other to live in St. Louis. Joseph worked at the Medart Foundry for a couple of months until he found his niche at the Missouri Botanical Garden, where he was a valued staff member from 1912 until 1946. He worked closely with George Pring on his water lily studies and was competent in many aspects of horticulture—a good all-round dependable man.

Joseph Cutak's wife, son, and 2 daughters came to St. Louis in 1915. The family had little opportunity for gardening in their old German neighborhood at Thirteenth and Emmett Streets. The tiny bricked yards reduced gardening to potted plants and window boxes. Lad's first contact with his future occupation was the small golden ball cactus his father brought to him from Missouri Botanical Garden.

"I've always liked the odd, bizarre characteristics of the cactus family;" Lad says, "what other plant family has such unusual members!"

It was to be several years before Lad's interest in cactus flowered into a career. In the meantime, he did so well in the St. Louis parochial schools that his parents and teachers destined him for the priesthood, sending him to St. Louis Preparatory Seminary. Lad did not go on to ordination in his seminary studies, but he has always appreciated the education the seminary provided. He wanted to enroll in art school, but the Cutak family had no funds for such educational refinements. Lad managed one semester at the Washington University Art School, and then had to concentrate on earning a living. He worked in a shoe factory for a time, until the factory changed hands, leaving Lad jobless.

Joe Cutak was assisting superintendent George Pring on his water lily research at this time and asked if there might be work for Lad at the Garden. In May, 1927, Lad Cutak joined the Missouri Botanical Garden as a temporary workman. He had previously helped Dr. Benjamin Duggar, who was later to be a co-discoverer of aureomycin, on a part-time basis, collecting horse dung for fungus cultures. The hailstorm that occured in the spring of 1927 was a tragedy, leaving all the greenhouses open to the elements, and dangerous because of the remaining shards of glass. Lad's first assignment was to pick up the glass which littered all the greenhouse floors.

As Lad says, "The hailstorm gave me my first toehold on a horticultural career. But it took me three years to wake up to the

Post-Dispatch

Lad collected aroids, bromeliads, and other tropical plants in Colombia for the initial plantings in the Climatron.

fact that I'd found more than a bread and butter job."

Lad stayed on, helping in the horticultural work of the greenhouses. Superintendent Pring commented, "It wasn't very long before I realized he had a natural love for plants. After a time, I suggested to Dr. Moore, who was then Director of the Garden, that we should give Lad the opportunity to take horticulture courses with the Garden students.

"So Lad was immediately enrolled in the Henry Shaw School of Botany, and both Dr. Moore and I were highly pleased as he made excellent grades."

Reminiscing about these early years, Lad said, "As I continued to work at the Garden, I spent more and more time in the Desert House because the cactus plants intrigued me so. Mr. Pring then put me in charge of the Desert House and later in charge of the main conservatory.

"As my knowledge and ability grew, so did my responsibility. Upon the death of my dad in 1946, I took over the exotic department: orchids, water lilies, and growing houses.

"I was then greenhouse superintendent until 1965, when I became manager of public relations for the Garden."

In 1934, at age 26, Lad was the youngest man in charge of a range of greenhouses at Missouri Botanical Garden, and already one of the country's leading cactus authorities.

"At the time my love for these strange plants began," Lad continued, "they were a neglected field of horticulture. This stimulated my curiosity, and I read everything I could find about them. At this time, I also began doing experimental work on the cactus."

The cactus craze struck this country in 1929, at the same time that this plant family was becoming Lad's overwhelming interest. This fortunate turn of events convinced Lad that cactus would be his career. He saw the opportunities available in popularizing these strange prickly plants and did a tremendous job of educating himself for this.

When Lad first took charge of the desert plants, there were only 138 named varieties of succulents at the Garden. So he began to get seed and cuttings from many sources until, by 1941, Lad had brought the number up to 1300 species of desert plants: the largest collection in the world of succulent plants under glass.

"My first chance to study cactus in the wild came in 1936,"

Post-Dispatch

Lad continues his work with specimen cacti in the greenhouses.

Lad said. "I traveled through the desert country of southwest Arizona, New Mexico, and Northern Mexico. There were many trips after that. I went to Mexico many times, the best trip being in 1947, when I really explored in the central, southern, and north-eastern parts of Mexico. On all these trips I studied and collected plants to enhance the collections at Missouri Botanical Garden."

One of Lad's most exciting trips was in 1960-61, when he went to the jungles of Colombia to collect aroids, bromeliads, and other tropical plants for the planting of the Climatron. By this time, Lad had become interested in plants other than his first love, the cactus. The interest in bromeliads, some orchids, and the other xerophytic plants that prefer dry hot desert climate were a natural outgrowth of the interest in cactus.

In the 42 years that Lad has been at the Garden, he has not only developed an amazing talent for growing cactus and succulents, but his warm, genial nature has endeared him to many—at the Garden and all around the world. He has traveled across our

country, Europe, and South America: a true ambassador of the Missouri Botanical Garden. His worldwide circle of friends range all the way from European counts and barons to retired ladies in south St. Louis.

He has lectured to countless groups since his first public talk in 1933, when he was a very shy scared boy telling the St. Louis Horticultural Society about cactus collecting. Lad has just received a great honor in recognition of the worldwide attention he has gained for St. Louis and the Missouri Botanical Garden through his work in the fields of cactus culture and succulent and tropical plants: In January of this year, he was awarded the St. Louis Newspaper Guild's Page One Civic Award for 1968.

Lad has also become an excellent photographer, and he is the author of 2 books, *Cactus Guide*, (Van Nostrand, 1956) and *Cactus Personified* (Wildcrafter, 1959). He has collaborated on other books, doing much of the writing, illustrating, and research. He founded the Henry Shaw Cactus Society in 1948 and is past president of the St. Louis Horticultural Society. He has written the "Spine Chats" in the *Cactus Journal* for years.

In 1965, Lad became manager of public relations for the Garden, and he keeps the Missouri Botanical Garden in the public eye with his displays and news articles; but he is still a horticulturist at heart and currently works with small specimen cacti in pots.

"Gardening is so varied," Lad says, "and has so many aspects that it offers a multitude of opportunities. I have been fortunate in that I've been able to focus my interests in art, writing, and people through horticulture."

TREES OF THE CITY

Kenneth Peck
(illustrated by Sandra Thornton)

IF YOU WANT to have a little fun and perhaps learn something at the same time, collect a handful of natural litter from a gutter some time in May. You may feel silly bending over to pick up leaves and seeds, but it only takes a moment. Place this debris in a small seed flat in which there is soil, and keep it watered. Chances are very good that within a week, some of the seeds will begin to germinate. After two weeks, nearly every kind of plant present in seed form will have emerged as a distinct and recognizable plant.

The seeds you collect will start out very well on a sunny windowsill. Since their habits are important to the story, it would be well to examine them closely with each daily watering. The large, winged seeds of silver maple at first lie flat but may have their "wings" raised straight into the air during the germination process. The smaller, disc-like seeds of elm are not as demonstrative. The young elm plants emerge very quietly and appear suddenly. Sycamore seeds are quiet too, but go through calisthenics similar to those of a person removing a tight sweater. Cottonwood seedlings appear in the midst of the soggy, tangled fluff which surrounds their seeds. How different the outward performance of each one is!

There may well be seeds of other plants coming up in your flat, such as dandelions, box elder, or perhaps tree-of-heaven. It may also happen that not all four of the trees mentioned first will appear on your sill. But if you had collected seeds from several locations, these four trees and possibly others should be present.

The trees we have talked about all appear in the city and older suburbs, where they were originally planted by people. With the exception of tree-of-heaven, they also grow naturally on the flood plains of rivers. If we were to make a comparison of features common to these four trees (silver maple, elm, sycamore, cottonwood) it would help us to understand why such trees succeed in cities almost as well as on river flood plains. To illustrate:

1. All the trees have seeds easily carried by wind or water. Look at the drawings: three have wings, one has fluff. Seeds carried by wind have little trouble getting around the city.

COTTONWOOD

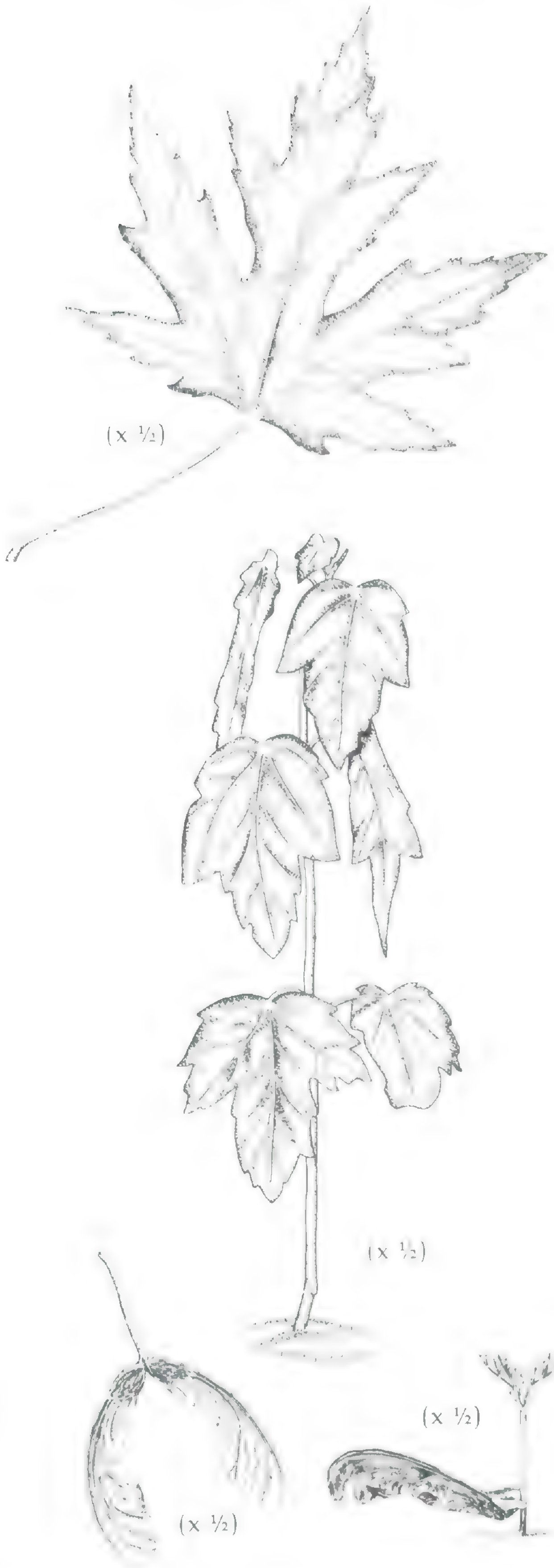
(x ½)

(x ½)

(x 2)

(x 2)

SILVER MAPLE



(x ½)

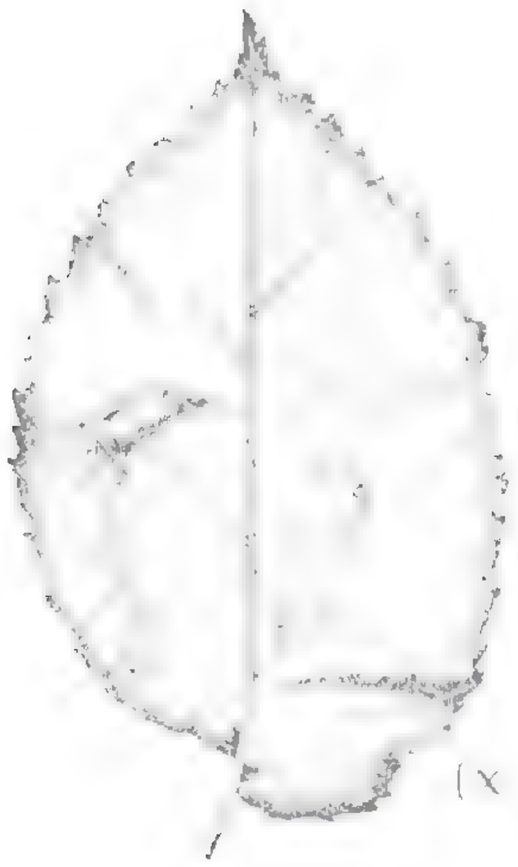
(x ½)

(x ½)

(x ½)

Leaves, seeds, and seedlings of four very common city trees whose natural home is the floodplains of large rivers. (Scale of drawings is indicated.)

AMERICAN ELM



(x $\frac{1}{2}$)

(x $\frac{1}{2}$)

(x $\frac{1}{2}$)

(x 1)

(x 1)

SYCAMORE

(x $\frac{1}{2}$)

(x $\frac{1}{2}$)

(x 1)

(x 1)

Kennet

Sequence showing 3 stages of the germination of a sycamore seed. Note that the firs seedling has germinated between 2 bricks.

2. Seeds of these trees must germinate soon after falling or they do not live. They are produced and released in the same spring; although sycamore seeds remain on the tree over winter and drop between late March and mid-May.

3. These seeds germinate best on bare mineral soil, which is moist, rather than on heavy accumulations of leaves or dense grass turf. In the city there are many situations where soil is covered neither by plants nor concrete, such as vacant lots and cracks in sidewalks. Along river banks, leaf accumulations are washed away or buried by deposits of silt every time the river overflows its banks, leaving areas of uncovered mineral soil.

4. These trees produce heavy seed crops almost every year, providing a better chance for them to get a start in places where we would not think of planting trees.

5. They grow rapidly both as seedlings and as maturing saplings.

If the pin oak had acorns with wings or parachutes, it would fit our little scheme quite well since it, too, can be found in abundance in the city and on the flood plains. Since the seeds are without any flying equipment, the pin oak depends on squirrels, and possibly birds to disperse the acorns around the community.

Any time you think that you are removed from nature in the city, just remember the trees from the flood plains that grow all around you. You can grab a handful of nature from the gutter if you will only take the time.

Publication of this article was supported in part by a grant to the Missouri Botanical Garden from the Arts and Education Council of Greater St. Louis. Reprints are being prepared for use and distribution in Garden education programs.

A WIDESPREAD NEW GENUS

Ellen and Kenneth Lissant

Dr. Ellen Lissant teaches botany at Fontbonne College. Her husband, Dr. Kenneth Lissant, is a research chemist at Petrolite Corporation.

DURING THE PERIOD following World War II when nuclear devices were being detonated in the atmosphere, much concern arose regarding the possibility of mutation rates rising and harmful mutants being produced. With closer control of nuclear testing and universal knowledge of genetics much of the furor has died down. Knowledgeable experts still express concern but the public has lost interest to a large extent. The common opinion seems to be that most mutations drastic enough to be serious are also lethal and therefore the problem is self-controlling.

To date there seems to be little evidence of the appearance of drastically changed genotypes in either animals or higher plants. We have recently, however, detected what we think may be a widespread and insidious invasion of large portions of the biosphere by a remarkable and until recently unrecognized mutant. It is not clear as yet whether this phenomenon represents a real threat to naturally occurring species or not. At present the danger appears minimal. It is known, however, that a number of ecological niches previously occupied by natural species have been almost completely taken over by the organism under discussion.

Our attention was first called to this situation some time ago when one of the authors of this paper noted a peculiar variant of *Coleus* in a planter box in a restaurant. Closer inspection disclosed that the individual plants were not *Coleus* at all, but a mimetic varia-

tion of some hitherto undescribed genus. The foliage of the plant bore a truly remarkable resemblance to *Coleus* but other structural details were clearly different. While the leaf orientation and phyllotaxis were much like *Coleus*, the cutinous layer of the stem was modified in a helical manner giving it a "wrapped" appearance. The root structure also was greatly atrophied or in some cases apparently absent. Observation of the specimens over a period of time disclosed that the metabolic rate and productive capacity of the plants were extremely low. No detectable growth was observed over a period of several weeks. No new leaves or buds appeared and few, if any, leaves dropped. Discussion with the owner of these plants disclosed that they require almost no care. "We dust them or wipe them off once in a while." If this is a mutation, evidence would indicate that it arose from a desert progenitor, or one adapted to a xerophytic environment.

The next instance of the occurence of this possible mutant was detected in a small courtyard off a hotel lobby. A number of normal *Fiscus elastica* and potted *Compositae* were observed, but one specimen of *Ficus* and one *Bambusa arundinacea* were found on close examination to be actually members of the same group as the *"Pseudo-Coleus"*. Again the general taxonomic features of the foliage were closely mimetic of the normal species but the main stem and branch junctions had the "wrapped" appearance, or seemed telescopically jointed.

Having been alerted to the possible existence of a new type of mutant plant we subsequently found many more examples of the group. In all cases the specimens were closely mimetic of well-known plants and were found to have invaded ecological niches previously occupied by normal plants under cultivation for decorative purposes, but where the normal plant required considerable care for successful cultivation, with special attention to limiting factors of light, temperature, and moisture. This selective invasion of inhospitable niches seems particularly unusual. Furthermore, we seldom, if ever, found juvenile or moribund specimens. All specimens were mimetic of the flowering or decorative vegetative stages of the normal plant.

Detailed examination of the structure of the specimens showed even more peculiarities. Rigidity of most leaves and stems facilitated microtome sectioning without the need for embedding in paraffin. Microscopic examination of leaf sections disclosed no apparent

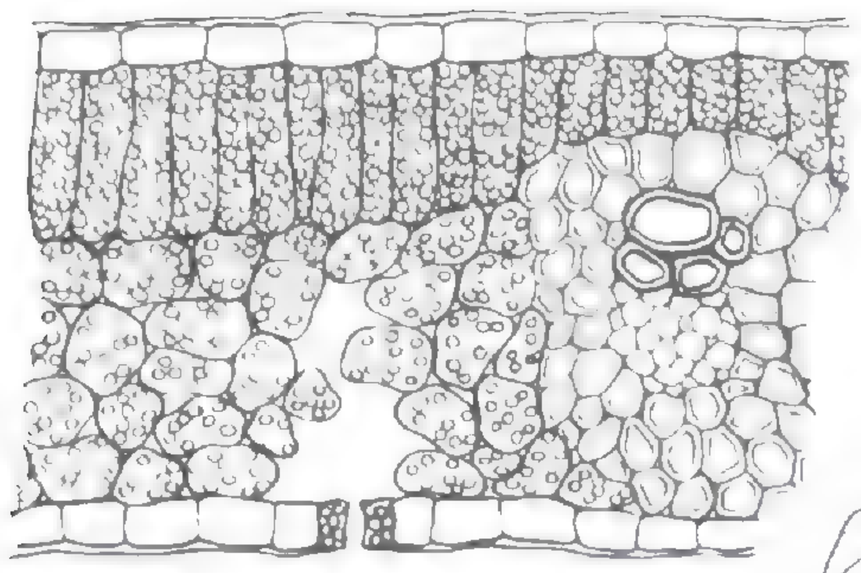


Fig. 1

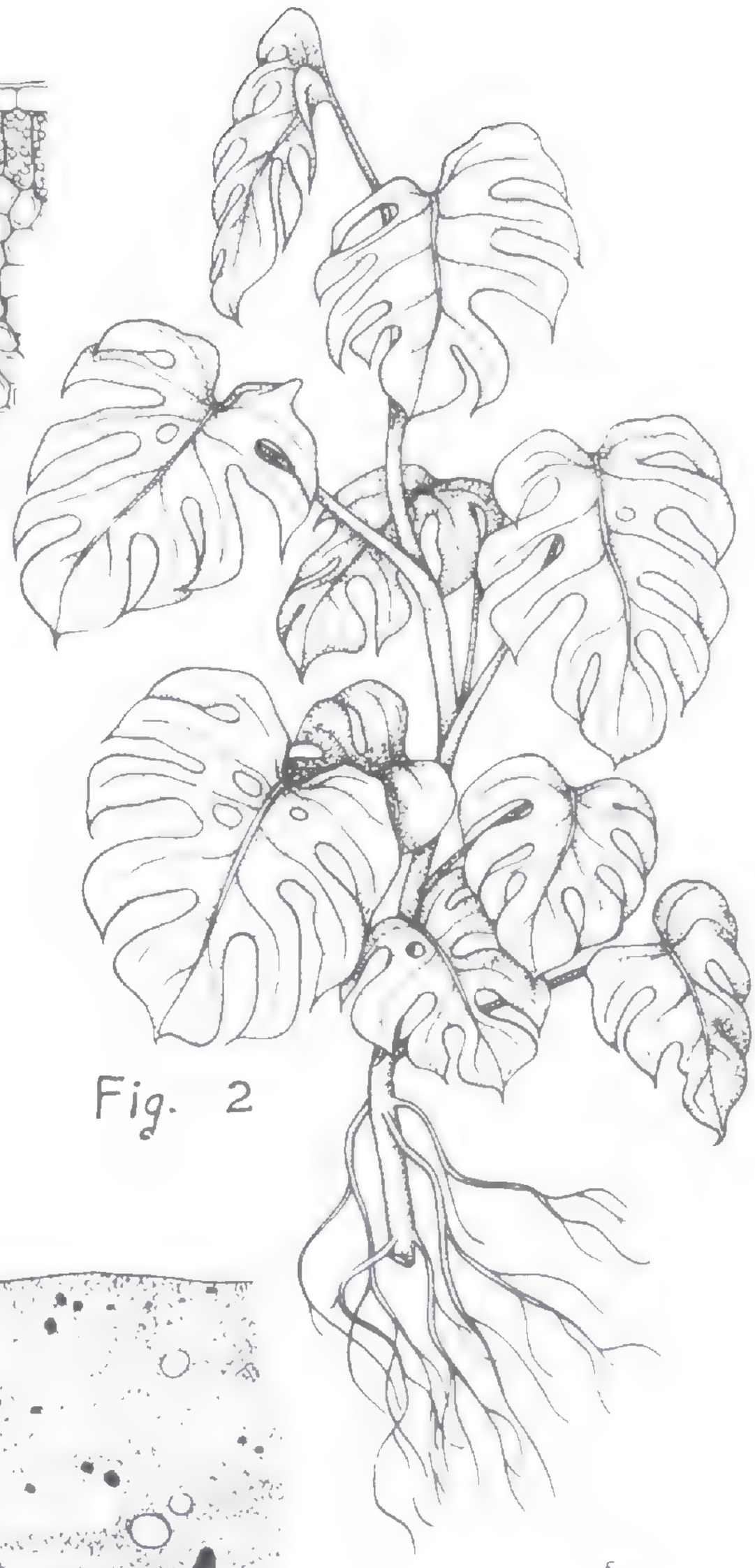


Fig. 2

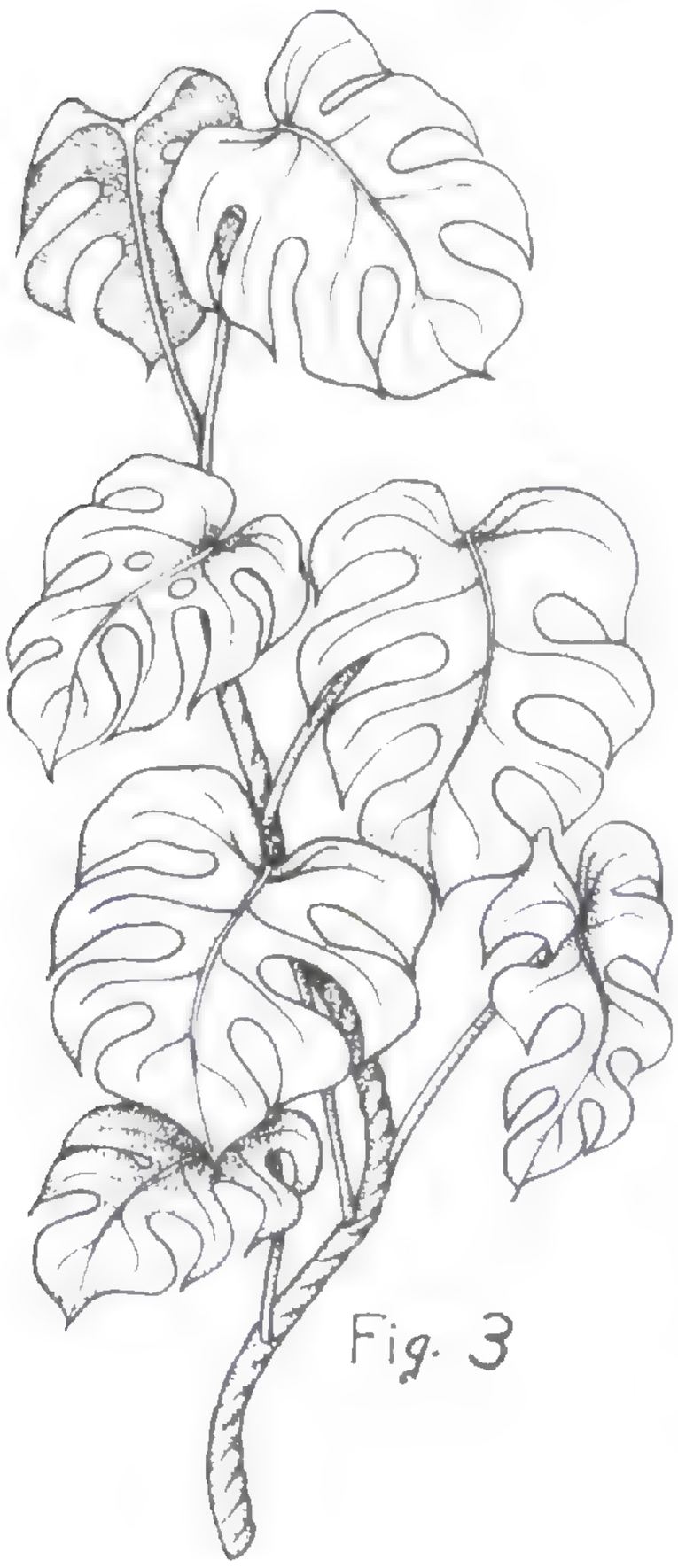


Fig. 3

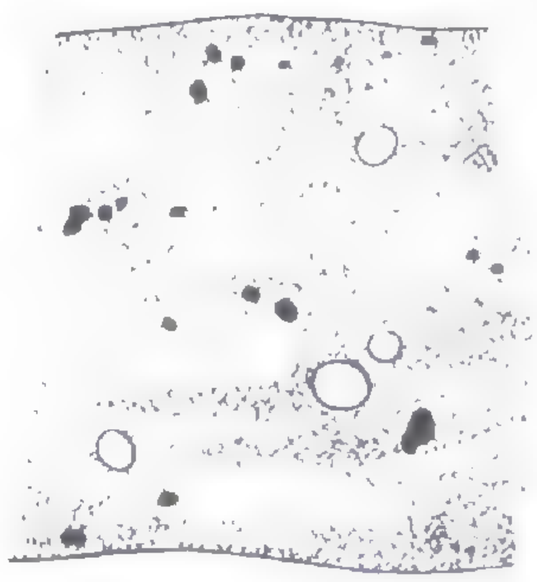


Fig. 4

FIG. 1. Section of *Monstera deliciosa* leaf, showing typical distribution of epidermal layers and stomata, palisade and spongy mesophyll, and veins of xylem, phloem and collenchyma cells. Note chloroplasts in mesophyll cells. FIG. 2. Habit of *M. deliciosa*. FIG. 3. Habit of *Vinylensis monstera*. Note "wrapped" appearance of stem, and absence of roots. FIG. 4. Section of *V. monstera* leaf, showing amorphous mesophyll with occasional air bubbles and pigment granules.

cellular structure: epidermal layers and stomata were lacking, and mesophyll was an amorphous mass containing no chloroplasts (Fig. 4). Chemical analysis of macerated leaf material showed that the composition contained no chlorophylls, carotenes or xanthophylls, and that the pigments were allied or identical to the "coal tar dyes," and that considerable inorganic material was occluded. Little or no cellulosic material was found except in the stems. The main constituents closely resembled polymers derived from aliphatic unsaturated hydrocarbons. We therefore propose as a name for this new genus *Vinylensis* and suggest that, because of its mimetic habit, species be designated by the generic name of the normal counterpart, e.g. *Vinylensis ficus*, *V. philodendron*, *V. coleus*, *V. chrysanthemum*. Specimens of *V. ficus*, *V. monstera* (Fig. 3, 4) and *V. coleus* have been collected.

New species and varieties are appearing with increasing rapidity and specimens may now be obtained at almost any florist shop and in many large department stores. It is felt that a botanical description of the genus should be delayed until more data can be collected.

Apparently a large number of the specimens now appearing on the market are imported from Japan—possible evidence that the original mutation was a result of either the Hiroshima or Nagasaki incident. We have not as yet been able to study the complete life cycle of any of the members of this genus since they have not as yet appeared as escapees in this country. None of the specimens we have observed have exhibited evidence of either sexual or vegetative propagation while under cultivation in the United States. Mass culture techniques apparently have been developed in Japan. It is reported that in the early stages of their development plants arise from an amorphous mass closely associated with a mold, and that temperature dependent phase transitions are essential for their development.

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From the Director

IN A RECENT issue of the Globe-Democrat, E. A. (Bill) Butler said, "When you can't attract the best executives to your community, your businesses are bound to suffer. Sagging companies mean sagging employment, extra relief costs, the acceleration of blight. Moreover the cost of attracting good men doubles and redoubles.

"Here is brutal proof of the damage a businessman does to himself as well as to his community when he contributes to air or water pollution, or fails to take an adequate interest in the environment around his factory."

The conservation and reclamation of earth's life, land, air, and water is vital to all mankind. Study and research in modern ecology uses the knowledge of all the natural sciences to tackle the environmental problems that are just beginning to be identified.

The solution of these problems is a task demanding the cooperation of the whole community, not just scientists and members of conservation groups.

Urban crises that have arisen by ignoring the environment are costing the entire community measurable amounts in real dollars and cents. Pollution and overcrowding cannot help but give a city an overall look of decadence and squalor.

When businesses are forced to use recruiters and public relation firms to lure executives into an area, by means of higher wages and extra side benefits, it's expensive. When businesses decide they can no longer fight the urban problems and decide to move out to a new area, it's expensive.

In either case the problems are still here. Young men and women in such places as the Missouri Botanical Garden are busy collecting data on the effects of pollutants, defining these problems that exist in our world. The scientific community can describe the issues and suggest solutions, but the entire community must be ready to help in providing the workable solutions.

David M. Gates

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Cover design by Peter Geist.
Illustration is from a woodcut of wild celery *(Apium)* in the *Latin Herbarius* printed by Peter Schöffer in Mainz in 1484.

GARDENING IN ST. LOUIS

JULY and AUGUST

SUMMER'S HEAT is not entirely without its blessings. Blue grass growth slows down and it's no longer necessary to mow every few days. Be sure not to cut blue grass shorter than three inches or remove more than 50 per cent of the total leaf surface.

Shade trees can be pruned at this time. Prune and shape spring flowering shrubs. Encourage new growth by cutting back old and non-productive branches to ground level. Old shrubs may be rejuvenated by carefully removing 1/3 of the oldest stems each year for several years.

Cutting old flowers and even shaping the growth of annuals will encourage better bloom through the summer and into the fall.

If you've followed our advice and continued to mulch flower beds, you should begin to see the improvement in soil both as to texture and moisture.

Soak lawns, trees, shrubs, and flower beds during prolonged dry spells or when soil is too dry. Water every five to ten days so that the soil is moist to the depth of six inches.

Continue with a conservative spraying and feeding program as needed, though evergreens probably should not be fertilized after June 1st.

You can learn to recognize horticultural needs by the general look of the plants. A good nurseryman will be glad to help you diagnose plant problems and prescribe the best sprays and fertilizers for given situations.

THE JERUSALEM ARTICHOKE

Helianthus tuberosus

Edgar Denison

Edgar Denison, retired Union Electric engineer, is a talented artist and skilled amateur naturalist.

THE JERUSALEM ARTICHOKE is a plant which offers one riddle after another. Is it a native North American plant? Early missionaries report that Canadian Indians cultivated them. The genus *Helianthus,* to which all species of sunflower belong, is an American genus and most of it's species are native within the boundaries of the United States. Let us assume, then, that *Helianthus tuberosus* is a native American. How did it get its strange name?

It is generally accepted that Jerusalem Artichoke is the name which came from mispronunciation of the Italian *girasole articiocco*. *Girasole* derives from *girare,* to turn, and *sole,* the sun. And as the sunflower gets its name from the phenomenon that it turns the flowerhead with the sun from East to West each day, that would make the Italian and English names synonymous. *Articiocco* means edible, and that is certainly true of the tubers. Unexplained remains the question, why an American plant should have an Italian name? The early voyagers were not Italians and neither were the first settlers. The pronunciation of *girasole articiocco* in Italian could well be misunderstood as Jerusalem Artichoke. But the name "edible sunflower" would have been a much better one.

The edible part of *H. tuberosus* is the tubers, which form on the roots in the same manner as with the potato. The Indians not only gathered these tubers but cultivated them. The plant is coarse looking, and can become huge when grown in rich soil with plenty of moisture. A row of them grown in fertile loam measured somewhat over 15 feet tall. But under natural conditions a height of from 5 to 12 feet is to be found. The leaves are eliptical, slightly toothed and hairy. They are commonly opposite, although plants with alternate leaves occur. The lowest leaves seem to clasp the stems. Almost always one finds little leaflets emerging from the axils of the big leaves, as shown in the center of the illustration. The flowers

The Jerusalem Artichoke *(Helianthus tuberosus)*

which appear late in the season, in September and October, are true "sunflowers"—composites with from 12 to 20 rays. The seed flowers in the center are perfect five-lobed little jewels.

Planting is done in late spring, in St. Louis around the middle of April, and the method is the same as with potatoes. A section of the tuber with one or more eyes is planted in well prepared soil and covered with two or three inches of dirt. Occasional watering during drought is desirable but not essential for survival. Harvesting can begin in the fall. The tubers can be left in the ground until needed and will not be damaged by light freezing. Once dug, the tubers will dry out unless kept moist.

It is difficult to describe the flavor of the tubers. The early set-must have become well acquainted with *H. tuberosus* since they were much dependent on what the Indians taught them. But, maybe because this was strange food eaten to avoid starvation or other reasons, the Jerusalem Artichoke did not stay in favor as table food in this country. It was grown for cattle and horse feed, and it was especially planted for swine, since they would dig their own tubers. During the Second World War the Department of Agriculture recommended growing the sunflower for human consumption and issued bulletins to encourage planting. One of the outstanding values of the tubers is that in contrast to potatoes they can be eaten by diabetics. Julian A. Steyermark writes in his FLORA OF MISSOURI, "The tubers . . . can be cooked into a vegetable. The texture is crisp and nutlike. The tubers may also be eaten raw and pickled. They contain a carbohydrate, inulin, in the form of a fruit sugar (levulose), which can be eaten by diabetic persons." Levulose is found in honey and in many fruits. Many cookbooks give recipes for a variety of treats: boiled, creamed au gratin, French-fried, a la Lyonnaise, mashed, with mushrooms in pancakes, pickled, and even cooked with Riesling or another white dinner wine. One French master chef grows almost lyrical about the wonderful tuber, which is much esteemed in France.

Yield depends on strain and soil fertility. In humus-rich garden soil and with plenty of moisture each plant will yield from 7 to 10 pounds of tubers. *Helianthus tuberosus* has a wide distribution all through the Middle West and into the southern part of Canada. Today it belongs in the vegetable garden, while in the past it was grown by the acre with yields of up to 20 tons under favorable conditions.

CHICORY

Botany By The Highway

Edgar Anderson

OF ALL MISSOURI'S roadside weeds and wild flowers, none is as bright along so many miles of roadway as the blue chicory; none stays colorful for so many weeks. Though it now edges thousands of miles of roadside with brilliant blue, it came to America as a garden plant. Its scientific name is *Chichorium intybus. Intybus* was the Latin name for chicory. In colonial gardens it was called "blue sailors," and this name persists in some eastern towns. There were even color forms of it. Around Boston, Massachusetts, there are frequently nearly as many white flowered plants as blue, and a curious gray-pink form is fairly common in certain neighborhoods there. In Missouri, the blue chicory covers the state except in the swamp-east counties; white-flowered plants are very rare, and I have never seen the pinky ones outside of New England.

As its name suggests, this same *Cichorium intybus* is also cultivated for its long tap root that, cleaned and dried, is the chicory of commerce. It was widely used as an adulturant of coffee when coffee was commonly made freshly-ground at home. In France and with many people of French descent, a coffee with much chicory in it is still preferred even though it costs more per pound. It has a bitter, rather medicinal taste, and when poured looks brownish rather than black. Much of what I have been served in the Caribbean area was dreadful stuff, but properly made in various Louisiana homes and restaurants, it was and still is very acceptable.

Cichorium intybus is widely used as a vegetable. The roots are dug up in autumn and forced into growth in the dark. The sprouts are marketed in St. Louis as witloof and sell for a fantastic price per pound. They are shiny white with traces of yellow and give a pleasant crispness and a slightly bitter taste to tossed salads. These same plants when grown by thrifty Italian families are used for their bright breen leaves of a faintly bitter taste in salads and sandwiches. Since they grow well in summer heat and the leaves can be picked off here and there all during the summer, it is unfortunate that chicory has not found its way into more home vegetable gardens.

THE REDBUD

Adaptation For Survival

S. Elwynn Taylor

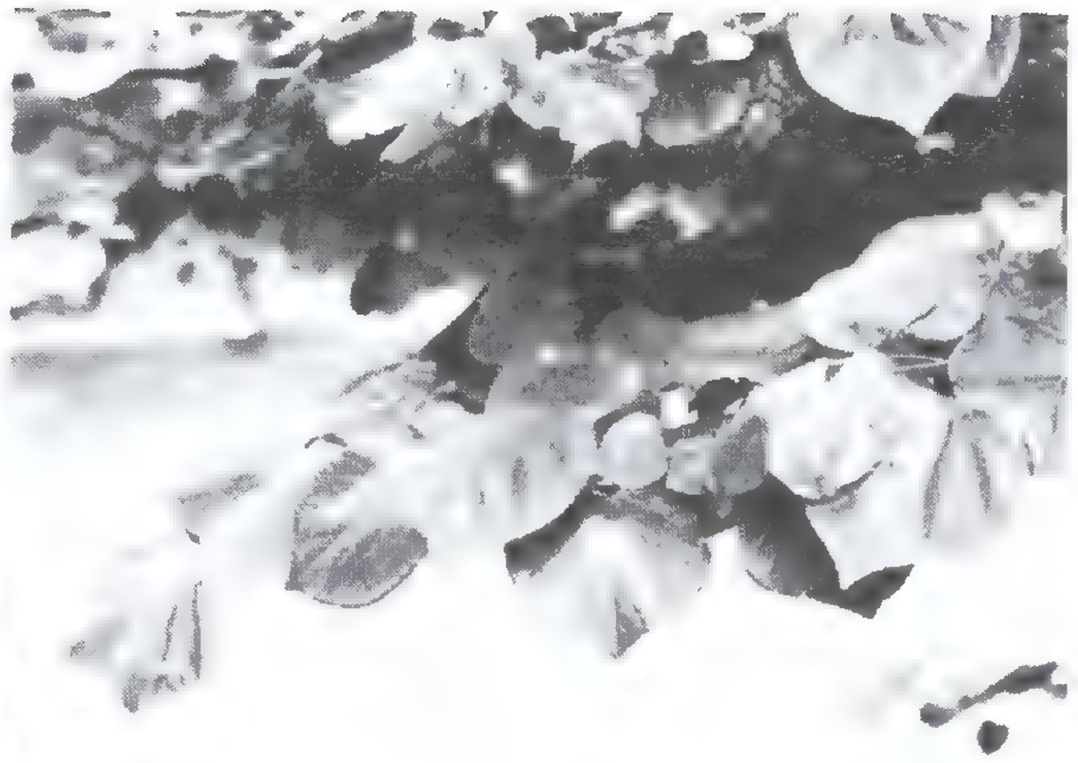
THE REDBUD *(Cercis canadensis)* is a plant of considerable interest in Missouri. The long-lasting display of colorful buds and flowers is a beautiful component of the April landscape. The tree has become a favorite of yards and parks.

To thrive, the redbud must be exposed to full sun at least half of the day. When shading results in the loss of the tree, it appears that the damage is more due to disease than other causes. The disease problem is much reduced in the sun.

A sun-loving native plant of Missouri that is not capable of growing taller than other trees is at a definite disadvantage in its native habitat. With the exception of the very wet and the very dry regions, the wilds of Missouri are generally thickly wooded. The zone where the forest stops and dry, harsh areas begin is the place to find this sun-loving little tree. Existence in this zone requires adaptation to heat stress and water shortage.

The broad leaf of the redbud is at a decided disadvantage in the hot, dry environment, for it tends to rise well above air temperature when exposed to intense solar radiation. If the temperature rise cannot be controlled by loss of water from the leaf (transpiration), the plant may very well suffer tissue damage due to excessive temperature. The redbud is generally not in a position to use a lot of water for evaporative cooling for there are often very critical water shortages at the glades and other exposed areas where the redbud finds its home.

The redbud cannot cool itself to any great extent by transpiration, but it has adapted to the environment by another means. The adaptive choices open are the reduction of leaf size, development of a tolerance to extremely high leaf temperatures (this adaptation is



Murray Gates

Left:
Leaves of the redbud oriented vertically. The orientation is viewed as an adaptation that prevents leaves from over-heating while conserving the water so vital to survival in the natural habitat of the redbud. The leaves are at 6 to 10°F cooler than they would be if horizontal.

Right:
In sharp contrast to leaves in the sun, these redbud leaves are almost perfectly horizontal and form a beautiful mosaic in shaded areas. Optimum interception of available sunlight where sun is scarce contrasts with the orientation of the leaves to intercept minimum solar energy when sunlight is in excess.

found among cacti), or adjusting the leaf orientation for minimum exposure to intense solar radiation. It appears that the redbud has done all three of these to some extent. The last, leaf orientation, is the primary adaptation and certainly the most striking to the observer.

The tree growing in an exposed environment is a common sight around St. Louis. When one first observes the tree, his thought is "The poor tree is all wilted," for the leaves all hang in a vertical position. A close inspection soon reveals that the leaves are not at all wilted but are firm and apparently healthy. When one walks to the shady portion of the tree, he may observe that the leaves are oriented horizontally, a sharp contrast to the sunny side with its wilted appearance.

On a very warm day in June 1967, members of our ecology research group made an evaluation of the effectiveness of the leaf orientation as an adaptive mechanism. We chose to study the redbud trees that grow along the edges of the glades at the Arboretum.

The plants on the glade were clearly reacting to environmental stress. There had been no rain for some time, and the soil was very dry. The blades of grass were folded in half lengthwise, thereby

reducing the leaf area by one-half and exposing the silvery white side only. The whole glade appeared dead and dry. Just a little rain would be sufficient to make the glades green and lush in a matter of minutes for the unfolding of the leaves would double the amount of leaf area and expose the green surfaces. The sky was very clear and the air was still and quite dry for Missouri (relative humidity 30%). The soil surface was quite hot, 46°C (115°F). The air temperature was 31°C (88°F). We began moving about the glade measuring leaf temperatures. The average redbud leaf in the sun was 10°C (18°F) *above* air temperature.

Our next task was to determine the temperature the leaves would attain if they were horizontal rather than in the vertical orientation observed all about us. Small frames laced with fine thread were used to gently lift and hold some leaves horizontal. The temperature of the horizontal leaves was noted and compared with the temperature of adjacent undisturbed leaves. Placing the leaves in a horizontal position had increased the environmental heat load by 17% and the horizontal leaves heated to almost 48°C (118°F)!

As a rule, plants do not tolerate sustained temperatures in excess of 45°C without severe damage to their tissues. Some damage was noted, but not to the extent we expected. The redbud has apparently adapted to withstand temperatures above that which can be tolerated by the average native Missouri plant.

Results reported by many investigators have shown that plants are most productive when the temperature of their leaves is below 40°C (104°F). The redbud controls the leaf orientation in the sun. The control results in leaf temperatures much nearer the point of optimum productivity than would be attained by a rigid or nonadjusting leaf.

Just a few feet into the vegetation to the side of the glade one finds leaves of redbud responding to a shaded environment. The shade leaves are oriented almost perfectly horizontal and no leaf of the branch appreciably shades any other leaf. The shade leaves are near air temperature and their orientation makes best use of the sunlight available to them. Here the leaves use their capability for orientation to intercept a maximum of the scarce sunlight; but a few feet away the leaves on the exposed branch are orienting to intercept a minimum of the sunlight which is so much in excess.

HAPPINESS IS A GARDEN

Derek Burch

THE ARTICLE in the March issue of the Bulletin seems to have struck a responsive chord with many readers who share my Ferdinand syndrome and like to have time to sit and smell the flowers in their yard. It is impossible to enjoy a garden unless your approach to it is rather relaxed, and I am firmly convinced that deep, regular mulching is one of the best ways to stay relaxed in the garden.

The beauty of this method is not only the immediate benefit of not needing to dig and having much less hoeing and weeding to do. It is also the peace of mind that comes from knowing that the soil, rich in humus and with an extremely active microbial population, is much less liable to suffer from the over-enthusiastic application of fertilizer, from incorrect liming or even from the accidental appl - cation of small quantities of poisonous substances.

The improvement in the texture of the ground after a period of mulch gardening gives a buffer against overwatering and the active root systems mean that every part of the soil is searched for food and water and that less care is needed to be sure that enough water is given.

The best rules in gardening are (1.) the area is there for your enjoyment and (2.) no expert can tell you what you should and should not be doing. My own approach is to crowd as many plants as

possible into an area so that they fill all the available spaces and do not leave any room for weeds to develop.

This, too, is a natural approach since all plants are in competition and a given space can hold just so many. I choose the plants that are going to fill this space and once they get established it is very hard for weeds to intrude.

I should admit that in part this way of designing is a rationalization of the fact that I like to grow things, and that I am constantly coming across plants that I want to try so that even if I started out with wide open spaces they would soon be filled as I tuck my new treasures in around the existing plantings.

The basic layout of my garden is a four foot module with raised flower beds, brick paving and a wood deck occupying various parts of the plan. In the raised beds we have enough shrubs to give some shape to the garden during the winter months but with plenty of space for summer annuals.

We aim for interest all year round so have chosen mostly early flowering shrubs that complement the flowers from the early bulbs. The bulbs take advantage of the sunshine reaching the ground while the shrubs are still leafless. When their display finishes and the leaves start to yellow, they are hidden by summer annuals that are planted in and around the clumps of bulbs.

This is relatively easy to do if the planting is done not in straight lines or rectangles but in curving groups with not all plants the same distance apart. A curving group like this has enough spaces in it so that the plants next in sequence for the area can be put partly in between the first plants. The successive groups should not coincide but should curve around and through one another to give a constantly changing picture in the bed.

This is much easier to do than to explain. It is helpful to know the final shape and color of whatever is being used but there are very few plants that will not go together in this rather informal manner and very few combinations that are so bad that they should be counted as mistakes!

Dense planting of this sort has the additional advantage that as one group matures and is removed it can be chopped up with pruning

shears and allowed to fall back onto the bed where it is immediately hidden by the next plants to develop in that area.

It is unfortunate that this "wild garden" approach is not applicable in all situations, but by changing the scale of the planting it works in city backyards on up to many-acre gardens. The mass of plant material gives some protection to developing shoots, and a failure in one type of flower may never be missed with all the other growth that is present.

I use my garden for whatever takes my fancy and do not restrict the annual plantings to flowers. So we have the additional bonus of tomatoes freshly picked from dwarf plants set in a sunny spot and can usually find the herbs that we need for cooking tucked in somewhere among the confusion in the garden.

Gardening is only worth doing if it is a pleasure. Once you begin to work with instead of against nature, your garden will have a healthy soil and a planting so dense that few weeds can survive. There are very few other problems left and you are then free to get to know your plants more intimately. By concentrating on the ones that do well for the majority of your plantings, you will have plenty of time for trying new things or simply for sitting and looking.

The Missouri Botanical Garden is a member of the St. Louis Arts and Education Council Sustaining Fund.

Garden to Preserve Old Roses

George Greene

THE BULLDOZER now uproots the prized roses of the 18th and 19th centuries, probing into their last hiding places in remote fence rows, abandoned farms, and cemeteries. Private collections of these old roses are also disappearing, and there are now but three nurseries left which feature them. The largest of these has recently cut its varieties by half; another is reducing its offerings to those that repeat their bloom more or less all summer.

The Old Rose Committee recently created by the Missouri Botanical Garden consists of Drs. Walter Lewis, Derek Burch, and Edgar Anderson, well-known and highly regarded members of the Garden staff; Mrs. John S. Lehmann, whose interest and support is making the collection possible; and the writer, whose contribution is time and a love of old roses generated originally by the late John S. Lehmann, former Garden president and early collector of old roses. This group is dedicated to preserving these vanishing varieties for future generations.

Over a hundred varieties of old roses now on order will be planted for a year or two in the extreme north end of the Garden for observation. Eventually space will be available on the west side of the Garden near Alfred Avenue for a permanent display, such as exists at the Arnold Arboretum near Boston. Planted in rows with plenty of space for each specimen, they will be left free to grow and bloom with minimum attention from the gardeners—an important consideration for the budget. Little attention is needed by these old garden gems.

For the six-week blooming season, Garden visitors will be able to walk among roses of great beauty and fragrance and learn their history. When this garden is completed in two or three years, one will be able to visit the Bifera Damask Rose, which is the twice-blooming Rose of Paestum mentioned by Vergil in his *Georgics*; the Red Rose of the House of Lancaster; the White Rose of the House of York (which is also the white rose of the Romans). Then there is a rose called "York and Lancaster," which has red petals and white,

From *The Fragrant Year* by Helen Van Pelt Wilson and Leonie Bell.
Copyright, 1967. (M. Barrows & Co., Inc.)

Damask rose, which has often been called Kazanlik: Known locally since 1949 as Greene Damask. This photograph from a drawing by Leonie Bell.

both in the same blossom. And there will be roses that are lighter and gayer, such as the pink moss.

Why were such interesting and beautiful roses abandoned? Was it because they were no longer beautiful? We think not. Beauty never changes; fashion does. It was fashion created by nurserymen who urged buyers to discard the old for the new. Greed is always close to fashion; new wine for old!

Nurserymen in France and England led their clientele to forsake roses that they had previously sold them. Lacking catalogs with huge illustrations in color, these nurserymen were just as effective in other ways in replacing the old with the new. Their customers were people of better than average means. Gardens were their concern, and the newest plant material catered to their pride. Imagine a home in fashionable Lucas Place about 1850, here in St. Louis. The latest rose is just in from Europe by sailing ship and river packet. Out go the old to make way for the new. The old plants were passed on to servants, friends, and servants' friends. The unpronounceable names of the displaced plants (nearly always French) disappeared promptly—who cared?

But the plants did find their ways into smaller settlements as people moved on. This is where the writer found them in his boyhood—in the yards of farmers, small town residences, and in the backyards of homes in the city. Even when these places were abandoned, the roses often lived on. Old roses seldom die; but they can be destroyed. In the Gallica type of old rose alone, there were over 1,000 varieties listed around the year 1850. Today, there are about 50 to 100. Gone are the weak, the garish, the unlovely. Only the beautiful varieties remain. Any lady of today would like her Victorian great-grandmother, love a corsage of moss roses for evening wear. And these old roses are the roses of artists—seen in drawings and paintings on walls and tapestries all the way back through history: the Crusades, Rome, Greece, Babylon, Egypt, China, as far back as we know.

These roses have an added appeal to most of us as they require little attention. You feed them a bit, prune a little, occasionally spray; but you are not everlastingly at it, as you are if you are a devotee of the modern rose with its demanding need for spraying, feeding, grooming.

There are two catalogs you may get which describe the names

and nature of old varieties available today. One is from Kern's Nursery, Box 33, Mentor, Ohio; the other Tillotson's Roses, 802 Brown Valley Road, Watsonville, California. The latter will cost a dollar, and is worth it—a work of art, with glowing descriptions and beautiful illustrations. Armchair gardeners will enjoy both of these literary efforts. These are the two nurseries from which most of our collection is coming. The third nursery, Sunningdale, in Surrey, England, sends out a "Manual of Shrub Roses"—a Bible for the old rose collector; price in English currency is 3 shillings. The accompanying price list is an additional three shillings.

Besides the purchased varieties, totalling about 150 to 200, we will acquire additional varieties from collectors and from other botanical gardens and friends who bring their heirloom roses in for identification.

The Garden has always responded to requests for such identification of old roses as well as other plant material. Perhaps now we are a little better set up for this service with our excellently staffed committee and our in-place collection-to-be, with a superb library, well-stocked with reference material, both books and catalogs.

The illustration with this article from *The Fragrant Year* by Helen Van Pelt Wilson and Leonie Bell shows a rose, discovered by this writer 20 years ago in a remote location in Illinois in front of an abandoned 2-story log cabin. (See April, 1953, Missouri Botanical Garden *Bulletin*).

In twenty years no one that I could discover had any knowledge of this rose which came to be known locally only as Greene Damask. I discovered in *The Fragrant Year* that the illustrator and I had independently searched for this rose's name and had recently found the same answer.

While the name, Rosa Damascena "Kazanlik", Bunyard, is unpoetic, it is none-the-less authentic enough to identify it clearly. I am hopeful that someone will succeed in finding a better name. And the rose itself? Well worth 20 years effort! Absolutely my favorite of all old roses! It will be featured in the Garden's collection and later be made available in nurseries.

The tales of these forgotten varieties often read like mystery stories. Garden visitors are lucky that they will soon be able to get acquainted with the great beauty and exquisite fragrance of these little-known old roses.

THE GARDEN and THE CITY

Barbara Lawton

A BOTANICAL GARDEN in the middle of a large city can and should play a significant role in the lives of urban people. The important thing for all mankind to understand at this point in history is that the success and well-being of man—his very survival—depend upon his ability to conserve earth's basic resources of air, land, water.

This need for understanding will not be solved by planting a few small city gardens. But if even a few young city dwellers can begin to grasp the importance and meaning of the natural world, the Missouri Botanical Garden's city projects are worthwhile.

There are children in St. Louis who have never planted a seed or seen a plant grow. They have never cared for a garden and so cannot know the joy of growing plants for food, for beauty, or for protection from the elements.

Insulated from the very earth by brick and concrete, inner city people do not have the opportunity to realize how thoroughly their lives depend upon the natural world.

Dr. Derek Burch and staff members of the Missouri Botanical Garden have been working on a series of city gardening projects. One is a "sitting and looking" garden in the Banneker School area, done with the help of a teacher, Mrs. Charles Tooker, the St. Louis Beautification Committee, and Dr. Samuel Soule (Dr. Soule had asked friends and family to give money for his birthday to the

Claude Johnston Photos

This small garden park near Banneker School now has a play area as well as a "sitting and looking" spot.

Project Johnny Appleseed has put 200 flowering and fruiting trees into the city.

Doing is so much better than just listening and looking as these young people from the Tandy area discovered while working with their plants in the Head House.

Missouri Botanical Garden for Dr. Burch's garden projects with inner city children).

The Johnny Appleseed Project in the north part of the city was done to get flowering and fruiting trees back into the inner city. Stark Bros. Nursery gave 200 trees. The Beautification Committee and Urban League spread the word. Pring Landscaping Co. distributed the trees. Mr. Edward Haberthier demonstrated pruning, and Dr. Burch supervised planting.

Dr. Burch also used Dr. Soule's Birthday Fund to help children of the Tandy area plant their own yards plus the Urban League backyard and a small children's park. This group of youngsters came to the Garden for a seed planting session.

The people and organizations who have worked on these projects have reached many St. Louis families and young people, helping them to make our city a better place to live.

ANIMAL COLORS: What Do They Do?

Owen Sexton

Dr. Owen J. Sexton is Professor of Biology at Washington University, a research ecologist on the Garden staff, and has an ecological research program based at Tyson Valley Research Center.

BRIGHT STARTLING colors smash at us in today's fashions—bold contrasts of purple and green, red and black, or magenta and electric blue. These colors do what they were designed for. They demand attention! If we look at colors in nature, however, we first become aware of masses of fairly uniform colors—the blues of the sky, the browns, yellows or reds of the earth, the green of growing vegetation.

On closer look we can distinguish much smaller patches of color contrasting with the more uniform background. Flowers are the most obvious examples, but they, too, may be abundant enough to create a broad effect. Their beauty is one of the major reasons we cultivate them in our homes or establish botanical gardens. From the flower's point of view, their colors have the same functions as those of a miniskirt: they attract attention.

Animal colors provide an interesting contrast to those of flowers, and they can be categorized into two groups. The first are concealing colors and the second revealing ones. Concealing colors protect animals from predators. For example, a local snake, the green snake, is rarely observed because it blends so well with the green of the low vegetation in which it lives. Again, the eggs of the killdeer,

laid in gravel bars, gravel roads, barren fields, etc., are so spotted with black on a drab background that they merge visually with their stony background.

Animals with revealing color patterns attract attention. Their bright and conspicuous patterns transmit information to either other individuals of the same species or to individuals of other species, primarily predators.

Within a species the information transmitted by a special color pattern acts to facilitate social interactions favorable to the survival of the species. For example, the general color patterns of several species of sea gulls are dull and extremely similar. An American ornithologist, Neal Smith, wondered how males and females of the same species recognize each other in breeding areas containing representatives of several species. He found that they did this on the basis of the color of the eye plus the surrounding fleshy ring. The female responds to the proper color of the male at the time of pair formation, but the male responds after pair formation, primarily at the time of copulation.

The often quoted work of well-known fish animal behaviorist Niko Tinbergen furnishes yet another example. Male three-spined stickleback fish establish territories (an area of the stream or pond bottom defended against invasion by other males) in which courtship will take place. Prior to the breeding period the fish is colored a protective greenish-gray which functions concealingly. With the advent of spring the colors now become very apparent, especially the belly which turns a conspicuous red, and this "redness" serves as a signal indicating that the male is in breeding condition and will defend his territory. Tinbergen has shown the role of the red abdomen by manufacturing models of sticklebacks and presenting them to territorial males. The shape of the models was relatively unimportant in eliciting attacks by the males, but red, particularly when on the bottom of the model, was very effective.

Information may be transmitted from an individual of one species (e.g., prey or a potential food item) to an individual of another species (a potential predator or eater). The function of this information is to decrease the likelihood that the predator will eat the prey. The efficiency of the system, though, depends upon other characteristics of some species of prey. These species, termed models, not

only have strongly contrasting and readily identifiable color patterns (e.g., alternating bars of black and orange as in milkweed bugs or the rings of yellow, red and black of coral snakes) but also some very obnoxious or dangerous quality. They may taste bad to a predator (milkweed bugs), sting (bees and wasps), smell badly (skunks) or be poisonous (coral snakes). Predators which have the misfortune of going after such models quickly experience the particular obnoxious quality of that prey species and tend to reject that food item. The prey, if not damaged too severely, will live and go about its business. The predator, if still alive, will learn to associate the obnoxious characteristic of the prey with its conspicuous color pattern and will avoid future encounters.

There are other equally conspicuous species which are not obnoxious but rather are extremely palatable. How are such obvious lunch counters able to avoid being eaten? On examination it appears that many such species are close duplicates of the unpalatable species discussed in the preceeding paragraph. These replicas, called mimics rely upon their resemblance to particular models to avoid predation. Hence, once a predator learns to avoid a model after a disasterous or unpleasant encounter, it will also tend to avoid the harmless mimic, no matter how palatable it may be. The mimics then are taking advantage of the experience the models gave the predators. A common example of such a model-mimic complex is that of the monarch butterfly and viceroy butterfly.

The bright colors of some animals have a highly specific role in the transmission of information from an individual to another of the same or of a different species. In many cases, however, the information transmitted acts not to increase the efficiency of close contact between the individuals (as in the case of many flowers and their insect pollinators) but to insure that no contact be made.

Please notify the Publications Department of any change of address.

MISSOURI BOTANICAL GARDEN TOUR OF SOUTH AMERICA

Ladislaus Cutak

THE AIR WAS HOT and humid in Rio as 20 touring gardeners stepped out of the Pan American jet at Galeao International Airport and headed for a cooling dip in the Atlantic. Our group often strolled barefooted along the darkened sands, when returning from evening meals at Copacabana's elite restaurants, and we were mystified by handmade depressions in the sand in which fetishes and lit candles flickered in eerie manner. Black magic and voodoo still persist in modern Rio.

Corcovado and Sugar Loaf are two of Rio's most famous landmarks. Although an auto road leads all the way to the 2,310 foot summit of Corcovado, our members chose the more adventurous cog railway with its two cars, open on all sides. The train jogs slowly up the steep flank of the mountain revealing majestic views of tropical forest on the slope cut by deep ravines. Tall trees are loaded with epiphytes, cacti, bromeliads, ferns, and other exotics. The broad, short rosettes of *Vriesea saundersii* had spikes of yellow blossoms. Mistletoe cactus *(Rhipsalis)* hung in slender streamers from many branches. Coffee trees had escaped to the slopes and grew along the right of way with *Calathea* and the ever popular *Impatiens.*

When we reached the top we were all impressed by the giant concrete monument of Christ the Redeemer. This massive statue, 130 feet tall, commemorates the first century of Brazilian independence from Portugal. As seen from below, the Christ statue with outstretched arms often seems to float in the sky as clouds obscure its base.

Sugar Loaf, a peculiarly shaped granite peak, soars 1,296 feet into the air. It was early in the morning when our group reached the station and already a crowd was forming to board the cable car that slowly glides to the summit. The car holds about 25 people and swings gently over the long void before it reaches the top of Urca Mountain, the first leg of the aerial ride to Sugar Loaf. From Urca there are magnificent views of city, mountain, and sea. A short walk on Urca to the other side brought us to the second station where we

boarded another cable car to Sugar Loaf itself. One side is as steep as if sliced by a giant knife; yet on the perpendicular face grow *Tillandsias* and orchids.

Sugar Loaf and Urca are both tastefully landscaped. *Malvaviscus* with its red flowers dominated the green verdure; mango trees were loaded with pearshaped fruit; *Plumeria* was resplendent with fragrant waxy blooms but was loaded with oversized caterpillars devouring its leaves. Bromeliads had escaped from borders and beds to the steep sides where they grew in wild abandon, and native cacti hugged the perpendicular walls.

Rio has a fine botanical garden situated not far from the sea where cool moist winds nourish the vegetation. In the distant background rises a wall of mountains, and one can see the imposing Corcovado with its towering Christ monument acting like a guardian over the lush garden below. The stately royal palms *(Roystonea regia)* form a delightful avenue, with trunks straight as an arrow, rising at least a hundred feet tall, surmounted by green shafts of waving feathery leaves. Many of these specimens are a hundred years old or more.

Lad Cutak

Row of stately royal palms in the Botanic Garden, Rio de Janeiro, Brazil.

Many other beautiful palms from the tropical countries of the world grow in the neatly manicured lawns of Jardim Botanico. We found the plants correctly labelled—a joy to both botanist and neophyte.

As our group wandered through the garden one could detect that some were greatly excited by other rare trees, such as the famed travelers palm *(Ravenala madagascariensis)* and the cannonball tree *(Couroupita guianensis)*, named for its odd fruit. Many of the trunks of palms and other trees were covered with the bromels and epiphytic cacti for which Brazil is noted.

We had the good fortune of having Dr. Roberto Burle Marx accompany us to Petropolis and Teresopolis, high in the Organs Mountains, northeast of Rio. He is a famous landscape architect who has planned and executed much of the public plantings in Brazilia as well as in Rio and other South American cities. We had a delightful visit to his nursery where he entertained us royally. This excursion gave us an idea of the Brazilian countryside. Along the road, mangrove swamps appeared with great patches of bracken fern and scattered cattails. As the road ascended, beautiful tibouchina trees were aglow with showers of blooms. This *Tibouchina granulosa* was common along roadsides and cultivated in parks and private gardens. At a rest stop, I saw for the first time wild andaassu trees *(Joannesia princeps)*, which I had grown from seed in the Climatron because the Indian name intrigued me. This is a tree of coastal Brazil which produces large stone-fruits that yield a powerful cathartic. I'm sure this same spot will be remembered by most of our gang. The owner kept a number of captive sloths on platforms built around the trunks of the andaassu. The sloth, a fascinating creature with unbelievably slow movements, lives entirely on leaves and does not wander far from where it secures its food.

The road wound to higher altitudes. Mist hung over the ridges blotting out the vegetation and then, as it slowly dissipated, revealed trees loaded with bromeliads. This region is rich in bromeliads—members of the pineapple family. It is said that one quarter of all known bromeliad species occur in southeastern Brazil.

In Petropolis, we visited some private gardens designed by Dr. Burle Marx, beginning with Mr. and Mrs. Alberto Kronsfoth's magnificent garden at their Rancho Pedro Azul. The owner is an orchid and bromel fancier. Near the entrance was an extensive bed of

Vriesea. Epidendrums were scattered in beds. A spectacular display of thousands of *Hemerocallis* (day lilies) and *Agapanthus* (the blue lily of the Nile) outline the ponds on a magnificent scale.

Another garden in which designer Marx takes great pride is that of Sra. Odette Monteiro. Pyramidal hills encircle this entire garden and vast sweeps of lawn extend to the foothills replanted with the finest of Brazil's native plants. The colors of *Bougainvillea* and *Tibouchina* dominated. Beside the man-made lake, a huge clump of *Monstera deliciosa* thrived in full sun. *Callistemon* or bottle brushes, introductions from Australia, vied for attention. At both Kronsfoth and Monteiro gardens are the beautiful homes of the owners. The ever present billowy clouds which hover over the entire scene make this area even more spectacular.

Sao Paulo is Brazil's largest city. For centuries it was nothing but a sleepy small town; then hundreds of important industries settled here to manufacture steel, automobiles, electronics, plastics, etc. Sao Paulo has grown rapidly and now the streets are filled with people.

From Sao Paulo a bus took us to Santos, a leading coffee port located on marshy land. Here we toured a warehouse where thousands of sacks of coffee were stored. An operator demonstrated how coffee is cleaned and sacked for shipment to all parts of the world. A visit to the Coffee Exchange was very interesting. Here bidders sit at round tables in a circular auditorium and transact business for this commodity. In another room we had opportunities to sample coffee brewed by attendants.

Santos has a public park known as the Orquidario. It is a very fine combination of zoo and botanical garden, accented with pools and attractive winding roadways. Flowering trees make splashes of color, and showy cattleyas as well as other orchids grow in trees. All kinds of water birds, including flamingos, flock around the waterways.

We arrived in Buenos Aires at night when the airport was almost deserted, and the air quite cool. Next morning we toured the city, admiring wide streets, elegant buildings, much sculptural art and, strangely, trees that reminded us of home. Sycamores and elms were everywhere, and occasionally there were more tropical trees like *Chorisia, Bauhinia,* and *Jacaranda*.

Pretty petite Elena Sole, a former airline stewardess, was our

Lad Cutak

Miss Elena Sole, our guide in Argentina, pointing out flowers of *Yucca aloifolia* in the patio garden of Baroness V. M. Neufforge.

guide who endeared herself to everyone in the party. She took us to the Cathedral, the Casa Rosada, the luxurious pink residence of the President, the famous Recoleta Church and adjoining cemetery where the cheapest mausoleum cost around $100,000.

Argentina will best be remembered for the visit to Bariloche, nestling in the Andes near the Chilean border. This recreational area lies in a natural park surrounding the picturesque Lago Nahuel Huapi. It is often referred to as the Switzerland of Argentina. Here there are wooded hills, lovely lakes, valleys and glades. The central feature of the park is the lake itself. Its waters are ice cold and blue black attesting to its great depth. Built on a hill overlooking the lake is the fabulous Llao-Llao Hotel where our group stayed. The lofty Lopez Peak towers above the hotel, but the mountain that stands out most is Tronador, perpetually snow-clad and hauntingly beautiful. It rises 11,400 feet high and was at one time a volcano.

We took a memorable trip by launch to Quetrihue Peninsula. This neck of land juts out into the lake and is noted for its forest of myrtle trees, *Myrceugenella apiculata*, which have cinnamon-colored

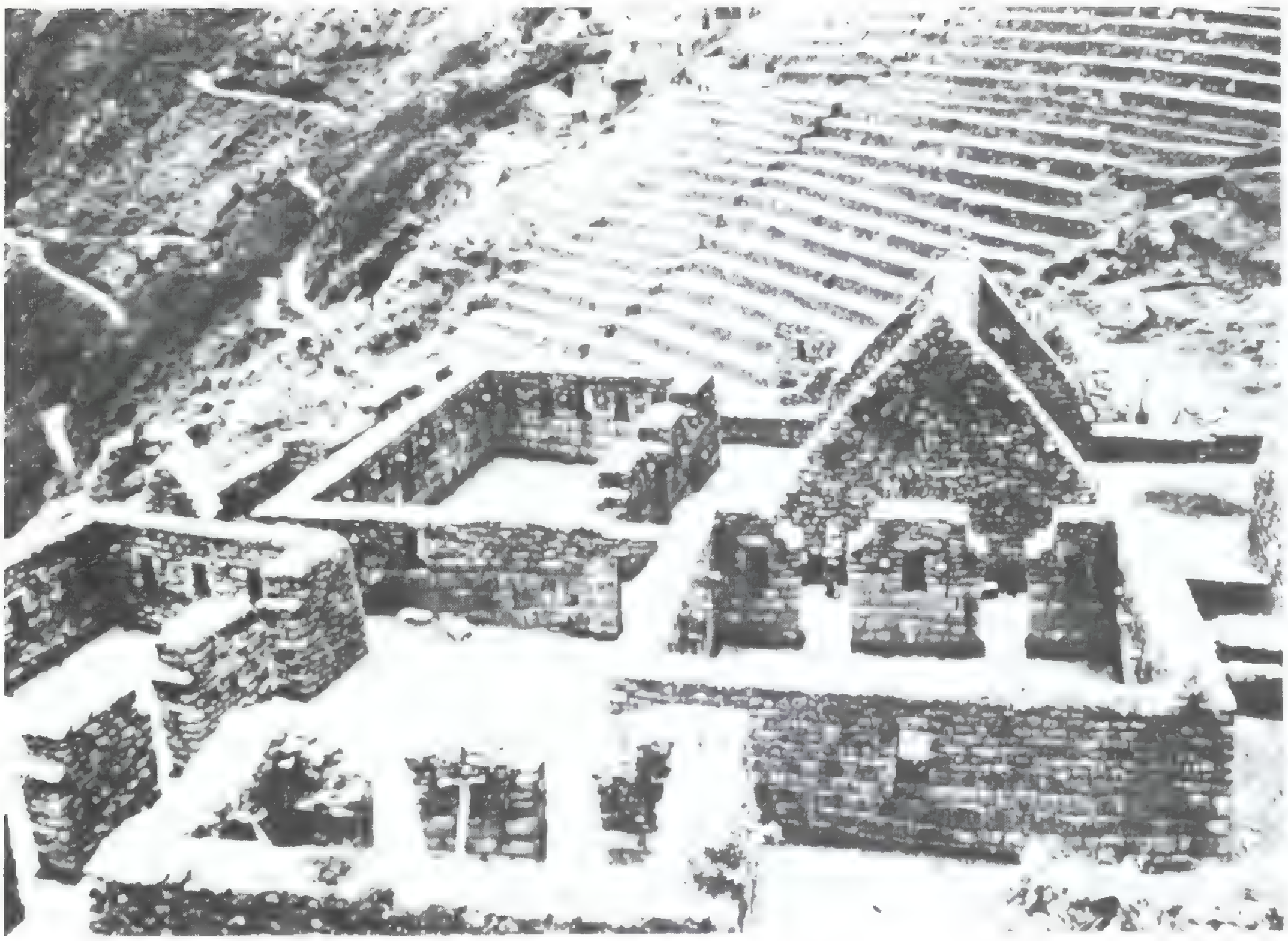
bark and typical small whitish myrtle-like flowers in dense clusters. The peculiar feature about the trees is the coldness of the trunks, even on warm sunny days. I know of no other trees whose trunks feel refrigerated and to date have not been able to find a suitable explanation for this phenomenon. Our guide boasted that this tree grows only on Quetrihue Peninsula, which of course, is a fallacy.

The launch also took us to Victoria Island. A kind of arboretum is maintained where many types of evergreens are grown, including introduced species from the United States. Bariloche is noted particularly for *Nothofagus*, the Andean beech. *Araucaria* is also grown.

There were many outstanding flowers peculiar to Bariloche. Patches of amancay *(Alstroemeria aurantiaca)*, which is related to the amaryllis, emblazoned the hillsides with yellow to orangish color. The daisy-like flowers of *Mutisia decurrens* are of a beautiful orangish color while those of the more common *M. retusa var. glaberrima* are whitish pink. I spent one whole morning exploring and photographing the wild flora, some so tiny I had to lie down to photograph them.

Lad Cutak

Betty Morgan, Margaret Kurrus, and Frankie Gardner beside a bed of California poppies on the grounds of Llao-Llao Hotel in Bariloche.



Lad Cutak

Remains of terrace gardens and Inca ruins in Machu Picchu, Peru.

The scenery was spectacular in every way, the vegetation very colorful, the air invigorating and clear. But the climax was still to come when we reached Peru.

Lima is now a thoroughly modern city with high-rise buildings and broad avenues. Barren Andean foothills nearly surround it, for Peru's capital lies in an arid region. Plants grow lush when irrigated by the waters of the Rio Rimac which come from melting snows of the higher mountains. It never gets too hot in Lima because of the cool Humboldt Current which flows fairly close to the shore.

In the barren sands outside of Lima there once existed an empire whose people worshipped the god Pachacamac, believed to be the Creator of the World. We visited the ruins which cover an extensive area on a most forbidding site. Some of the walls made of adobe brick and stone are still in a fair state of preservation. Nothing grows in this waste of sand except *Tillandsia straminea*, a tough member of the pineapple family.

In just such a region of wasteland, we came upon a most delightful garden belonging to Raphael and Elvira Puga. At one time the

estate was a Dominican monastery, but where monks once walked, there now are a bull ring, pens for fighting cocks, a beautiful exotic garden and a patio or courtyard with cacti and succulents.

We visited a second garden, also surrounded by hills of sand, which proved again that beauty can be created in the hostile sand when water is supplied. In this garden, owned by Senor Malespina, there was a large pool filled with hardy and tropical waterlilies. The lawn, neatly manicured, was accented in just the right spots with flowering bushes and small trees. Geraniums and lantanas cast reflections in the water from borders around the pool.

The train from Cuzoo to Machu Picchu zigzagged up the slope in several switchbacks and then descended into the wild gorge of the Urubamba River. The waters of the Urubamba at this time of the year were very turbulent, frothing and fuming as they raced on their way to the Amazon in a boulder-strewn river bed.

When the train reached its destination, we were hustled into small busses that were to take us across the swollen river, up the steep slopes to the famous Incan ruins of Machu Picchu. This citadel is located in one of the most inaccessible parts of the canyon, about 1500 feet above the Urubamba. All around are towering peaks and it is no wonder that the Conquistadores were never able to locate it. Machu Picchu was the last hideout of the Incas and it existed unmolested for nearly half a century after the Spaniards conquered Peru. Mysteriously Machu Picchu was swallowed by the jungle and was forgotten for nearly four centuries. Professor Hiram Bingham of Yale University rediscovered it in July, 1911, on an expedition searching for lost Incan cities. He came to these ruins after five frustrating months, knew he had a real find, and started archeological excavations. Machu Picchu is now one of the wonders of the world.

Our gang scampered all over the ruins which are scattered over various levels. Terraces occupy steep slopes where early agriculture was practiced. Orchids, ferns, bromels, and other tropical plants grow in the crevices of the ruins and cover the cliff sides in dense masses. Begonias, calceolarias, peperomias were conspicuous everywhere. While resting after much climbing, our thoughts went back to the Incan Empire in all its glory. What grandeur must have existed in this city set between the awesome peaks of Machu Picchu and Huayna Picchu!

This visit climaxed a wonderful trip for all of us on the first garden tour sponsored by the Missouri Botanical Garden.

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(SHAW'S GARDEN)

The Missouri Botanical Garden's main entrance is at Tower Grove and Flora Place. The Garden is served by both the Sarah (No. 42) and the Southampton (No. 80) city bus lines.

The Missouri Botanical Garden Arboretum—1600 acres—established at Gray Summit, Missouri, in 1926, is open to the public.

The Garden—70 acres—is open every day except Christmas and New Year's. For the main entrance, grounds, Climatron, display greenhouses, and Floral Display House:

May 1 through October 31 . . . . 9:00 a.m. to 6:00 p.m.
November 1 through April 30 9:00 a.m. to 5:00 p.m.
Sundays and Holidays . . . . . 9:00 a.m. to 7:00 p.m.

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November 1 through April 30 10:00 a.m. to 4:00 p.m.

The Display House presents four major shows: November, Chrysanthemums; December, Poinsettias; February, Orchids; April, Spring Flower Show. During the year other shows, competitions, and festivals are sponsored by various garden clubs and flower societies.

Courses in botany and horticulture for adults are conducted by the Garden staff. Children's nature classes are provided free on Saturdays from mid-September to early June. The Pitzman Nature Program is held for children during the summer. The Garden is world famous for its scientific research program. The scientists of the Garden hold teaching appointments on the staff of Washington University.

The Missouri Botanical Garden was established for the public's benefit in 1859 by Henry Shaw. The Garden, a non-profit institution, relies for support solely upon contributions from the public, the Arts and Education Council, and income from the Shaw estate. The Garden receives no city or state tax support.

Support your Garden and take part in Garden activities through the Friends of the Garden. Information may be obtained from the Main Gate or by mail or phone (865-0440).

MISSOURI BOTANICAL GARDEN

BULLETIN

VOLUME LVII NUMBER 5

SEPTEMBER-OCTOBER 1969

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A Great Man, A Great Botanist

Edgar Anderson

DR. EDGAR ANDERSON'S perception of all events and living things within his view was incredible. All the more so because he could translate his perception into language with meaning to any intelligent person. How many among you can explain or even mention his greatest contribution to science—introgressive hybridization—a great theory of ecological genetics. Introgression is the gradual infiltration of the germplasm of one species into that of another species.

Two closely related species of plants would have slight differences of color or of leaf shape or of some other feature. But also each species would have different habitat requirements of light, of soil type, or of moisture or nutrients. In order that second generation hybrids could survive and introgressive hybridization proceed, a hybrid habitat was needed. If one species required sunlight and the other species required shade the second generation hybrid required a habitat with some shade and some sun.

This all sounds simple enough, but such simplicity was buried in a world of infinite variation and complexity; in a world of many species and diverse habitats. Yet Dr. Anderson after years of study and meticulous observation of nature was able to demonstrate his remarkable theory by means of the native iris of the Mississippi Delta. It was here on a narrow French farm, where overgrazing occurred, that he found the right combination of disturbed habitat which maintained the hybrid colony. The parent species grew on neighboring farms right up to the fence line, but only the hybrids on the overgrazed farm. No ordinary man would discover this subtle blending of man and nature. For his perception, resulting in this discovery, he was elected to membership in the National Academy of Sciences—the highest honor America can bestow on a scientist. For his humility, integrity, generosity, and humanitarianism—Dr. Anderson will hold a place in the minds of his friends forever. All who knew him are grateful he came our way.

—David M. Gates,
Director

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Cover design by Peter Geist. Illustration is from a woodcut of a lily *(Liliaceae* family*)* in the *Latin Herbarius* printed by Peter Schöffer in Mainz in 1484.

EDGAR ANDERSON

November 9, 1897—June 18, 1969

DR. EDGAR ANDERSON, a great man and a great botanist, died suddenly of a heart attack at his home on the Garden's grounds on June 19, 1969. He had devoted 46 years of his life to the Missouri Botanical Garden and Washington University.

A memorial program was held on June 23 in the old Museum Building which he had helped restore and in which he had his laboratory.

"Edgar Anderson was exceptional—exceptional of mind, of spirit, and of purpose. His mind was unusually perceptive, remarkably retentive, and incredibly interpretive. The images of his mind were so close to the surface that he could translate them into unique artistic expression in writing and speech," said Dr. Gates, Director of the Garden, and then went on to illustrate Dr. Anderson's keen wit.

"One day, many years ago, he was having an argument with another great biologist and neither could seem to get the upper hand. Finally, in exasperation, Dr. Anderson stopped abruptly and said curtly, 'The trouble with you is that you have a sea level mind.'"

Dr. Fritz Went, former Director of the Garden, said in a telegram, "We mourn Edgar, original and dedicated mind, botanist extraordinary, friend and mentor."

"Herb ladies were as much a part of the life of Dr. Anderson as bees to the hive," said Mary Baer, who told of his part in the founding of the Herb Society of America and our St. Louis Herb Society. Mrs. Baer added, "We remember well, and will treasure long, the huge doses of herbal knowledge which, in a deep and abiding sense of humility and humor, Edgar Anderson has dispensed to us, his fledglings."

Victor Hamburger, former Chairman of the Biology Department at Washington University, spoke of the scientific side, "Edgar was a true scholar; a profound and original thinker. He had an unobtrusive yet powerful impact on Washington University, as a productive scientist and a born teacher in the classroom and even more so in the field. He knew how to communicate with young people, partly because this was his special gift and partly because he was an astute observer of man. He knew as much about people as about plants."

One of Anderson's recent students, Ray Altevogt, said, "Edgar

Dr. Anderson, shown here in his laboratory where he did much of his research on the ancestry of corn. (c. 1948)

Anderson's attitude toward his students is summarized in the dedication of his book, *Introgressive Hybridization*, which says, 'To my students, With pleasure in what they have learned, With pride in what they have taught me.'"

"Edgar not only was a Botanist in the grandest old sense of that word, but he tried his level best to make real botanists of all of us," said Erna Eisendrath, a student and associate, and added, "He always tried to bridge the gulf between his scientific knowledge and the curiosity of the layman."

"A few years ago I looked through a single issue of *Brittonia*, the publication of the American Society of Plant Taxonomists," said Hugh Cutler, another former student and collaborator, "and found that three fourths of the articles were based on work by Dr. Anderson or used his methods. These tangible results of Edgar's special talents assure a certain kind of continuity or immortality, but the most lasting effect is the impact he left on people."

Harriet Bakewell, the daughter of Dr. Moore, one of the Garden's past directors, knew Dr. Anderson from the first day he came to the Garden. She noted, "He left a lasting impression on all who knew him . . . as a great human being. He had a sharp wit and enjoyed poking holes in people's established ideas, thus stimulating them to real thought."

Leicester Faust spoke for both the Board of Trustees and himself, saying, "We shall all miss Edgar Anderson and the many botanical advices he was always ready to give. His years of association with the Missouri Botanical Garden were filled with many great accomplishments and these will fortunately remain as his valued contribution to our Garden."

Edgar Anderson was a writer of quantity as well as quality. Bulletin readers have enjoyed his articles for many years. It was always a delight to find articles by Dr. Anderson on my desk, for without exception his articles are clear, informative, and full of the sparkle of his keen observation and humor.

In tribute to Dr. Anderson, this issue of the Bulletin contains four previously unpublished gems of Andersonia. Future Bulletins will carry more of his wonderful views, reviews, and commentary.

—The Editor

What I Found Out About the Corn Plant

by
Edgar Anderson

BETWEEN 1941 AND 1954, I published fourteen major papers on corn* and its relatives which have influenced corn breeding in the U.S. and elsewhere. Most of them are highly technical. Much of the evidence they present was from fields outside the knowledge of other corn geneticists and most corn breeders. My colleagues at the Garden and the university, my own relatives, would like a short account in plain English, of the significance of these publications which I produced in collaboration with some of my graduate students and with scholars in other fields. The whole program is described in the following phrase: To study the plain old-fashioned Botany of Corn with the greatest possible precision.

I took my Doctor's degree in Genetics under E. M. East, one of the two scientists who independently discovered the Inbred-Hybrid technique of producing better corn, but the only one of the two who carried on investigations which ultimately led to its practical success. I learned much about corn from Dr. East and his graduate students, though my own problem for the Doctorate was on flowering nicotines and he also encouraged me to study ornamental trees and shrubs in the Arnold Arboretum. From Harvard I came directly to the Missouri Botanical Garden and Washington University where my most important job was to teach Genetics to graduate and under-

* I am using this in its common American sense and not as in England where an "ear of corn" refers to what Americans would call a spike of wheat, and a "corn field" is the common name for a wheat field.

graduate students. Many of them were studying Plant Taxonomy (the classification of plants). Within a year I was absorbing the fundamentals of it from my brilliant students, Mildred Mathias, Carl Epling, and Robert E. Woodson. As I learned more and more from them and from other students, I conferred more and more with *their* teacher and *my* colleague, Professor J. M. Greenman. Gradually I realized that between Genetics and Taxonomy there was a wide field in which no one was working. My own students have mostly been described as working in the field of Ethnobotany (the effects on each other of man and the plants he associates with) or of Biosystematics (the basic Genetics of whole populations of one sort of plant or animal).

However, when Mangelsdorf and Reeves demonstrated that corn could be crossed with a grassy weed, *Tripsacum*, I started to study corn and *Tripsacum* as a taxonomist would study two grasses that interested him; particularly if like me he was well on his way to helping discover the new field of Biosystematics. Corn, after all, is just a giant grass out of the tropics whose seeds we use for food. Corn had long been supposed to be derived from teosinte, a big weedy grass, found here and there in Latin-American corn fields. As I worked over the taxonomic evidence concerning these two grasses, I realized it would turn the old theory exactly upside down. Teosinte might have come *from* corn crossed with *Tripsacum*, it could never have been its chief ancestor! When I mentioned my new theory to Mangelsdorf, he listened but practically forgot it, until in studying the grandchildren of the cross between these two giant grasses, he ran into unexpected results that called it to mind. When Mangelsdorf and Reeves published their epoch-making monograph: *The origin of Indian corn and its relatives*, in 1939, they gave me adequate credit for having first suggested this relationship.

I soon had many new ideas about corn that I wanted to try out experimentally but it is impractical to grow even a small plot of experimental corn at a botanical garden in the midst of a big city. Help came to me unasked from the Pioneer Hi-Bred Corn Company of Des Moines, founded by Henry Wallace. He told his colleagues "This company was founded on a theory of hybrid vigor that everyone thought was a crazy idea. We should be receptive to crazy ideas about corn breeding!" His firm invited me to Iowa to lecture and eventually to come back and study their inbreds and hybrids in any way I pleased; all this at their expense. At the end of that visit, Raymond Baker (in charge of the corn-

breeding department) and I made an unwritten agreement that each of us would take an interest in what the other was doing. This gentleman's agreement is still in force. The money spent on me and my graduate students and the planting, care, harvesting, and storage of much experimental corn has all been spent without any formal contact.

A few years later, the company wanted to hire me to organize and direct a basic research program on corn breeding. I suggested they hire Dr. William L. Brown who had taken his doctorate with me studying lawn grasses and had since become a successful sweet-corn breeder. He was brought to Des Moines and is now the Vice President of Research of this many-sided company. He is still my closest friend.

Working together, we learned that the corn of the U.S. cornbelt is the world's most important source of hybrid vigor. Compared to all the rest of the corn elsewhere in the world, it is unique. *It is not the kind of corn we got from the Indians* but a legacy from hard-pressed pioneers of the early and mid-eighteen hundreds. As they pushed their way slowly northward and westward, they brought with them the productive southern varieties of corn which had traveled up from Mexico by various routes. These varieties were mostly white, had many-rowed, chunky ears of dented kernels and were often killed out in cold, wet springs. At such times these pioneers replanted the frozen spots in the fields with the much hardier varieties of corn their ancestors got from the Indians. They had long narrow ears with 8-10 rows of flinty kernels that were most commonly golden yellow in color, sometimes with a flush of red. In this way, the "northern flints" and the "southern dents" produced mongrelized fields, mixed yellow and white, but with great hybrid vigor. It was this yeasty mixture that produced the "cornbelt dents". Dr. Brown and I repeated the cross and got hybrids of tremendous vigor but even among the grandchildren, great grandchildren and great great grandchildren of the cross we could not duplicate perfectly the corn-belt dents. We returned to the study of this same cross (Longfellow Flint x Gourd-Seed Dent) in 1968 and expect to continue it in 1969. That may further illuminate this and other corn breeding problems. All this is just the most important thread in the tangled history of corn that Dr. Brown and I have worked on together. As a kind of Appendix, here is a listing of four other ideas that have helped corn breeders.

1. Latin-American corns form a net-work of more or less distinct races, connected by intermediates much as is shown by the races and subraces of *Homo sapiens*.
2. Distinctive popcorns associated with each major race. At least some of these are known to be the ancient primitive ancestor of that race.
3. Strange popcorns still grown by savage peoples in Central Asia are unlike any recognized races of popcorn in South America.
4. A few corn breeders have realized the value of our methods for studying variation in corn tassels.

In conclusion, it has become apparent that I have learned more from the best of the corn breeders I associated with, then they have learned from me. Aristotle said that every science began as an art and ended as a philosophy. The most important aspect of these studies on corn is that they are carrying the art of corn-breeding farther along the path to the science of corn breeding.

MISSOURI CEDARS

In the White River country of southwestern Missouri, *Juniperus canadensis*, is joined by its close relative, *Juniperus ashei*, the Mexican Cedar, which has brown heart wood instead of red, a larger juicier berry, and a round bushy shape to the tree itself. The two cedars have hybridized a good deal but the hybrids have mostly crossed back to one or the other parent. The end result is that as one drives south and east from Springfield, Missouri, he finds both the Red Cedars and the Mexican Cedars are indeed variable. E.A.

Ecology and the Duck Pond

Edgar Anderson

ECOLOGY IS NOT a word that many of us use lightly in our general conversations. Nor, upon hearing it, would we be likely to relate it to one of the happiest of Sunday afternoon scenes: small children and their parents feeding ducks in the ponds of our parks across the country. Yet, at Duck Pond, located in the University of Wisconsin's arboretum, an ecological problem has arisen because of this old family pastime. Professor Grant Cottam, Chairman of the Arboretum Committee, describes how, in an article appearing in the fall, 1968, issue of the University's *Arboretum News*.

"When we consider the problems caused by the interaction of man and the environment on the Arboretum, we usually think in terms of mechanization and industrialization. There are other types of problems where the villain seems to be very innocuous and the activities completely harmless. Such a situation exists at the Spring Trail Pond, more familiarly known as the Duck Pond, and the problem arises from the interaction of two very charming animals, ducks and small children.

"The Duck Pond has been a Madison institution for a long time. It is beautifully landscaped, and has a population of semi-domesticated mallards. For years there was a sign on Nakoma Road, which is one of the major highways entering Madison that said, "Caution, Ducks Crossing." The ducks nest in Nakoma and the sight of a mallard hen leading her young brood across the highway back to the Duck Pond is fairly common. Because the ducks are so tame and the area is so accessible, a tradition has arisen among many Madisonians to take their toddlers to the Duck Pond and let them watch and feed the ducks. Older children use the area and the marsh behind it as a place to explore nature. Frogs and turtles have been abundant in the marsh, and we hope the populations of these animals will maintain themselves in spite of the notorious collecting propensities of the budding nature lovers. The pond never freezes, and on cold winter mornings the steam and the ducks rising from it make a sight that is spectacular and beautiful.

"The problem is, simply, there are too many ducks and they get too much food. Spring Trail Pond is small and the duck population approaches one hundred. They get so much food that it is quite common to find them completely disinterested when some small child tries to throw dried bread, corn, or marshmallows to them. The excess food and excrement from the ducks is causing a serious pollution problem. The water from the pond runs into Lake Wingra and adds its load of nutrients and pollutants to the other sources arising from the urban areas surrounding Lake Wingra. The pollution is a potential health hazard and the problem requires immediate attention.

"But there is no easy solution. We have to reduce the size of the duck population in a humane way without causing too much consternation among the small fry, and we have to persuade these children, and their parents to stop feeding the ducks. We have plans for raising the water level and doing some dredging in the pond, and want to do additional work in the area including paving of the parking lot. The area shows the signs of heavy usage and we would like to make it more attractive. But it is already too attractive to some segments of the population.

"It is easy to get indignant about the Beltline Highway with its constant stream of traffic, but when you are dealing with ducks and small children it is not quite so easy to tell where your sympathies lie. But for the good of the ducks, and children, and the Arboretum, we must improve the situation at Spring Trail Pond."

This little story is a good illustration of the meaning of ecology in our every day lives. There is a lesson there for all of us who are interested in the Garden's Arboretum at Gray Summit and in others like it. It shows us that a love of wild flowers and wild animals is not enough for the wise administering of a wild-life reservation; one must also have sympathetic understanding for the people who come to the Arboretum for legitimate purposes. While we do not have a problem like the one described in Madison, we have others just as complex. The story demonstrates that some of the tough problems encountered in our wild-life preserves demand technical training, intelligence, and common sense, and good hard facts about the interactions between an arboretum and its visitors. As Professor Cottam points out, it is basically an ecological problem.

THE RED HIBISCUS I

Edgar Anderson

ONE OF OUR MOST spectacular native perennials in Eastern North America is *Hibiscus coccineus* native, writes Miss Caroline Dorman in her *Flowers Of The Deep South*, "in swamps near the coast, Florida to Texas and Northward." The stems are up to eight feet in height, the flowers are shaped like a bowl and can be eight inches across. They are a brilliant scarlet and glow when the sunshine hits them. *Hibiscus coccineus* is not winter hardy in St. Louis.

I have a hardy hybrid produced at the Blandy Experimental Farm of the University of Virginia by Bruce A. Perry, then working toward his doctorate under Dr. Orland E. White, the Director of the Experimental Farm. Dr. White took a special interest in hardy or semi-hardy strains of sub-tropical plants and had obtained seeds of *coccineus* from near Richmond, Virginia, which must be close to the northern limit of its distribution. Dr. White turned the whole Blandy Farm collection of hibiscus over to Bruce Perry to study and hybrids with it flowered in the summer of 1941 when I was working there as a guest investigator. Dr. Bruce Perry, now a professor at Texas A. and M. writes as follows about the hibiscus: "Among the seedlings from *H. coccineus* were eight obvious hybrids."

It was one of these that I brought back to St. Louis. I finally planted it in full sun at the Cleveland Gate House of the Missouri Botanical Garden where it got reflected heat from the white lime-stone walls of the house and it has never been damaged by the cold, though the young stems, coming up in the spring, have been injured by trespassers. There it caught the eye of a St. Louis lawyer, Ralph K. Soebbing, who had received a similar hibiscus from a friend of his and had learned how spectacularly beautiful it can be in the St. Louis area. At our request he has written about its value for his own garden.

The Illustrated Dictionary of Gardening,
Vol. II, Nicholson, 1890 3.

The red hibiscus *(Hibiscus coccineus)*

THE RED HIBISCUS II

Ralph W. Soebbing

THE red hibiscus *(Hibiscus coccineus)* is a magnificent shrub-like perennial native to swamps and low-lying areas from Florida north to Georgia and Alabama. It can, however, be grown in dryer sites outside its natural range. It responds well to cultivation and seems to be quite hardy in the St. Louis area. The author's plants have survived recent winters without any special protection other than a moderate mulch; moreover, the red hibiscus seems to thrive on our summer heat and is not seriously troubled by any insects or plant diseases.

Under favorable conditions a well-established plant will produce numerous stems and reach a height of six to eight feet or even ten feet. The scarlet-red funnel-formed flowers are borne individually in the leaf axils and extend up to six inches across. The irregularly-toothed leaves are deeply cleft, especially the upper ones which appear to be almost divided. Although each flower is open but a single day, new flowers appear daily in such profusion that this is not a serious fault. In the latitude of St. Louis, flower buds first appear early in July, and actual flowering continues until mid-September. Red hibiscus should not be confused with the rose mallow, *Hibiscus moscheutos*, commonly seen in St. Louis gardens. *Coccineus* is a distinct plant having a grace and beauty all its own. The adjective red seems especially appropriate as the plant stems and leaf veins all have a reddish hue overcast with a whitish bloom. Surprisingly enough, the red hibiscus appears to be relatively unknown in the St. Louis area. Perhaps even the young plants are too large and bulky for convenient handling by nurserymen or dealers in perennial plants. In any event, the red hibiscus has such outstanding qualities that it would seem to deserve greater popularity. It makes an excellent specimen or background plant wherever there is sufficient room to permit its development.

The Purple and Copper Beeches

Fagus sylvatica

(With Some Remarks about Beeches in General)

Edgar Anderson

THE GARDEN HAS three fine specimens of copper beeches which are getting to the size where they make a real display in the landscape and are of more general interest to visitors each year. One is to the right as you approach the main entrance of Tower Grove, Mr. Shaw's country home. It was set out in the early 1930's and is now as high as the eaves of Tower Grove House; European beeches grow slowly, compared to many American trees. There is another of the same age, set out at the same time, facing the rear entrance at the north end of the Administration Building. The third, planted well before 1900, is between the Floral Display House and the African Succulent House. Exposed to reflected heat and light from these two greenhouses, till recently somewhat crowded by nearby trees; it has grown much more slowly than the other two beeches. It was stunted for a while by the smoke damage before St. Louis achieved smoke control. It was in Henry Shaw's original arboretum (which persisted until the 1920's) and was probably planted before his death in 1889. It shows its age in the picturesque wrinkled bark of the trunk. This is particularly noticeable on bright winter days. Discerning photographers are beginning to learn the effective close-up it makes at that time of year, in color or in black and white.

Red or purple-leaved sports from the normal condition are known for a good many of our trees. They were popular in central Europe in the nineteenth century and were sold by many nurseries. At present only a few are common in the trade in the United States, red-leaved Norway maples, red and purple-leaved flowering crab applies, and purple-leaved flowering plums.

There is a little red coloring matter in the epidermis of many normal leaves if you hunt for it under the microscope, but in these

Claude Johnston

Discerning photographers are noticing the effective bark and branching patterns of the copper beech in winter.

colored-leaved "sports" there is so much that it shows to the naked eye. Perhaps such trees have lost some inhibitor which is in normal plants and keeps the color under control. M. B. Crane, who studied its inheritance in the red-leaved apples, found that it was inherited in a simple fashion and was due to a single gene. Given this gene, the plants had colored leaves (varying all the way from light pinkish red in some seedlings to deep blackish purple in others).

The colored-leaved beeches also vary in shade when they are raised from seed. Some are a dark purple-green; there is one form whose leaves are an intense black-purple. Those whose foliage is a brighter, redder purple (particularly in the springtime and on actively growing branches) are called copper beeches; duller, less reddish trees, are known as purple beeches. Most experts classify all of them as different forms of the purple beech but the coppery ones have been much more popular; as a term in common speech, "copper beech" has made its way into the Concise Oxford Dictionary which says nothing about the purple beech. The color is brightest on the undersides of terminal leaves on vigorous-growing branches. One finds it there even in mid-summer, mid-veins and side-veins of brilliant pink rising above a leaf surface of metallic purple-green. The color is certainly affected by the climate; copper beeches in the neighborhood of London are about as bright in mid-July as they are in St. Louis in early May. Having known copper beeches in England, it was not until I made careful comparisons twig by twig with a tree of known origin that I was sure all three of ours are copper beeches.

Copper and purple beeches are commoner in the parks and gardens of the eastern states than in the midwest. They are one of the glories of England where in such show places as Windsor Castle they rise to heights of over 80 feet. Clothed with wide-spreading branches practically to the ground, they look like coppery mounds when seen from a distance. They have been a favored ornamental in Denmark, are frequent in Holland, Germany, and neighboring countries. A leading English daffodil breeder screened his seedling beds with clipped hedges of copper beech.

All these trees are frequently said to trace back to a single beech tree in a forest near Sondershausen in central Germany from which they have been raised as grafts and seedlings. Copper beeches do not seed freely even in central Europe but when good seed can be obtained it yields a good proportion of colored seedlings. However, beeches with colored leaves have an even older history in other parts

Beech leaves are most distinctive in their texture. Shaw Camera

of Europe. There is a possibility that the Sondershausen specimen may have been brought in from Switzerland in the first place.

In 1680 a book on the natural curiosities of Switzerland described red beeches: "A beech wood at Buch (German for beech) on Irchel Mountain contains three beech trees with red leaves such as are nowhere else to be found." Further details are given in a volume published in 1706: "At the holy feast of Whitsuntide these beeches offer to our sight a marvelously beautiful red so that peasants dwelling within the limits of a two hour journey are accustomed to break off leaves and twigs from these blood-red beeches and carry them home in their hats." Apparently the custom of plundering the trees for festive branches once a year was not too good for the trees. The latest information reported only one tree still surviving.

Beech leaves are distinctive; they have a neater look about them than the leaves of most other trees. The long mid-veins and the side-veins which rise from them are as straight as if drawn with a ruler.

They go all the way to the margin, terminating in a point. In the copper beeches, the points protrude only a little, giving a sinuous character to the leaf margin. In our American species, *Fagus grandiflora*, they stick out much farther, forming conspicuous teeth along the leaf edge.

It is in its texture that a beech leaf is most distinctive. It is thin, tough, and pliable, like a brand-new dollar bill. You can hold a leaf between thumb and forefinger of each hand and snap it back and forth without tearing it. When you have learned just how much tension it will stand, you can produce sharp little snaps, it is so thin and tough and flexible.

The winter buds, too, are distinctive and graceful. They are over half an inch long, slender and light brown, evenly drawn out to a long, tapering, sharp point. The separate scales are deeper colored at the exposed edge; their regular overlappings make a pattern for the eye. The buds of the American species are so much more slender that they seem longer, though they are really about the same length. They are a redder and shinier brown and are quite handsome.

The American beech is a larger, more open, more picturesque tree than the European species. It is less formal looking and it frequently holds many of its pale dried leaves until the following springtime. It is widespread in the East from Canada to Florida but it avoids the prairies and the plains. From Indiana its range drops down to southern Illinois and southeastern Missouri, then across Arkansas to Louisiana and east Texas.

The European species, *Fagus sylvatica*, is common from England and Sweden southward to the Alps and the Carpathians where it forms great forests, sometimes almost pure stands. Along the mountains it spreads southward through Italy as far as Mt. Etna in Sicily. Eastward in Europe it avoids the treeless steppes (just as our beech avoids the prairies and plains) and reaches its eastern limit in Rumania.

In our experience the European beech is slow-growing but long-lived. It responds to even moderate care, watering during severe droughts and light mulches in hot summers. Very little grass grows under it as it matures; but if it is not in competition with other trees nearby, the branches can be allowed to develop nearly down to the ground and are handsome when so treated. Fortunately for us it does particularly well in limestone areas and its tough slender branches are seldom injured in our high winds and sleet storms.

GARDENING IN ST. LOUIS

SEPTEMBER and OCTOBER

ST. LOUIS HAS HAD its usual dose of unusual weather this year. Above normal rainfall during the first half of the year made gardens especially lush. Annuals will keep blooming until killing frosts occur if wilted flowers are cut to prevent seeding.

An ample supply of subsoil moisture should make this fall especially good for planting new shrubs and such perennials as peonies, oriental poppies, iris, and, of course, spring-flowering bulbs. This planting should be completed well before the ground is frozen to allow plenty of time for fall root growth.

Mow lawns as long as the grass continues to grow. For best results bluegrass should be sown in late August and the first half of September. Bluegrass seed will germinate in a week at this time of the year if the surface is kept moist by daily sprinkling. Fertilize lawns with a good all round formula such as 5-10-5 or 10-6-4.

Don't let the falling leaves get ahead of you. Wet matted leaves can ruin the appearance of any lawn. An amazing quantity of raked leaves can be used as mulch in and around flower beds, shrubbery, and low growing trees. If you prefer, establish a compost pile in your service area and use the decayed leaves as you would peat moss.

Get a cold frame in order. Even a small one can overwinter a large amount of plant material to set out in the spring. (Friends of the Garden may write for free instructions on the construction and use of a cold frame. Send your request by mail with a stamped self-addressed envelope to the Education Department, Missouri Botanical Garden, 2315 Tower Grove Ave., St. Louis, 63110)

BOTANISTS AND ELECTRONS

What does the new electron microscope reveal to garden researchers?

Walter H. Lewis

A NEW AND COMPLEX instrument, the Scanning Electron Microscope (SEM), is making a dramatic effect on classification and evolution studies by botanists. Knowing that the microscope (Fig. 1) would project surfaces of hard objects, we decided to test its worth on pollen grains taken directly from herbarium specimens and from living flowers.

The microscope is housed and maintained by the Department of Pathology of the Washington University Medical School under Dr. Marie Greider. Through the interest of Dr. Greider and Dr. John E. Ridgway, Jr. I was given the opportunity of using the instrument for pollen studies. All pollen photos were taken with expertise by Terry Luikart and Charles Thurkill assisted by Claude Johnston in developing. This work is being sponsored by a National Science Foundation Grant GB-5042.

Our research to date on pollen using only the light microscope had shown severe shortcomings; even transmission electron microscopy would not help in our quest to observe clearly the pollen wall.

The SEM differs from the standard transmission electron microscope in that the electron beam, instead of passing through a thin specimen, sees only the surface of an object. The scattered primary electrons, plus secondary ones emitted by the object, pollen in this case, are then amplified and form an image of the surface on the face of a cathode-ray tube. There are no lenses between the pollen and the screen where the magnified image is displayed and photographed.

Our results with both dried and fresh pollen proved magnificent: greater magnification rendered invisible objects visible, and improved resolution and depth of field produced clarity in three dimensional form not believed possible.

As examples we might look first at the pollen of our spring beauty (Fig. 2-4), still enclosed partially by the anther. A cluster of three grains shows the long furrows from which pollen tubes will emerge, and a third photograph illustrates surface wall detail with dark pock

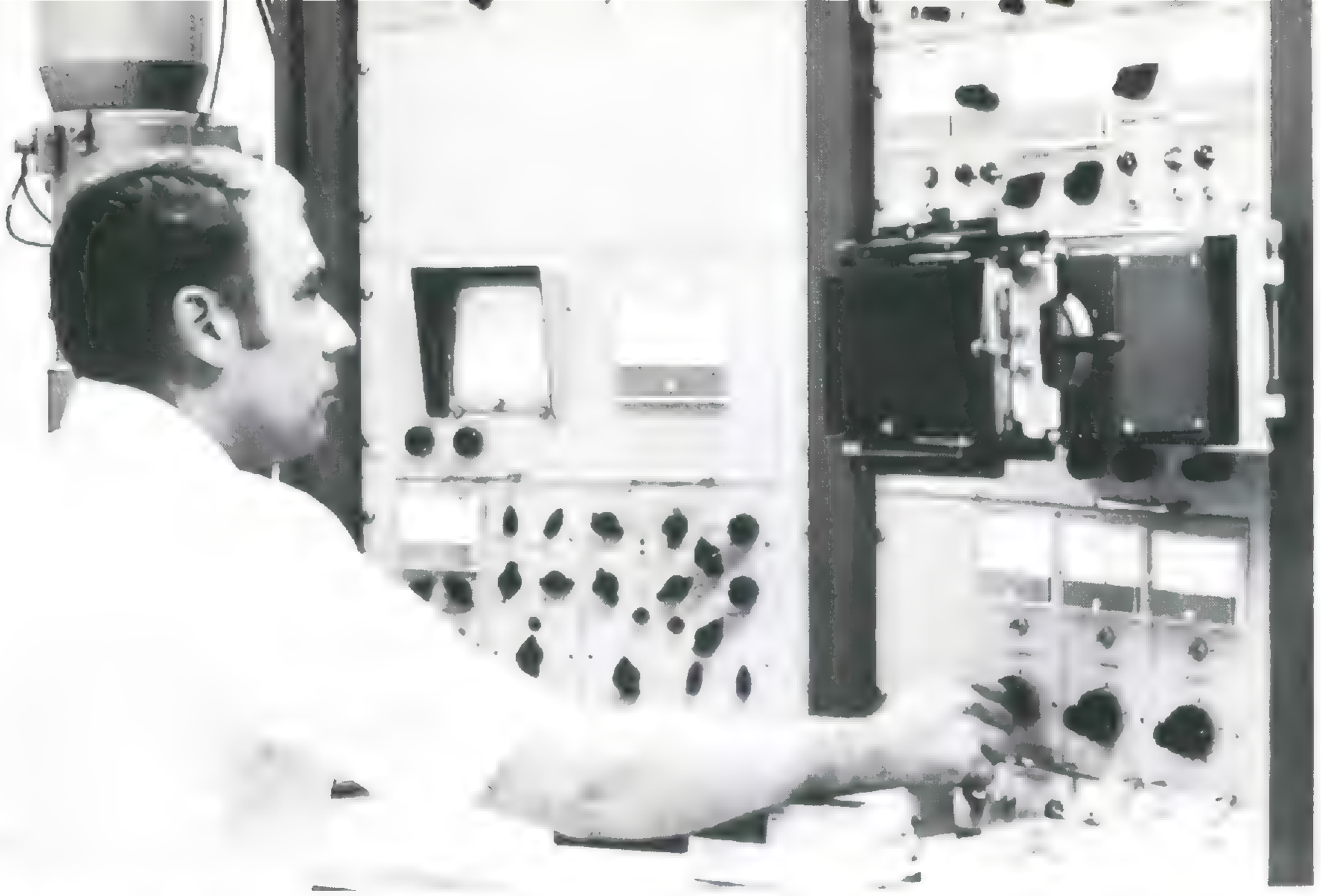

Fig. 1. The Scanning Electron Microscope at Washington University being used by Terry Luikart.

marks and very fine, whitish spines. These have never before been seen. Who would have thought that pollen of hibiscus (Fig. 5) would look like explosive water mines or that cattail pollen would have a single pore which apparently lacks definite form (Fig. 6-7).

More dramatic still are detailed surfaces of pollen walls enlarged 11,400 and 15,275 times. A Mexican member of the coffee family *(Didymaea mexicana,* Fig. 8) shows, for example, a continuous network of ridges with irregular small spines. The pollen surface of a Texas flax reveals small and large rods interconnected by a wavy membrane-like network (Fig. 9). How simple to identify pollen of these species when such detail is visible!

The SEM is very helpful with the more complex pollen grains. We can see the characteristic clumping of cape-jasmine grains (Fig. 10) into four, observe a single pore of *Mapouria* pollen (Fig. 11), and study the intricate furrow surrounded by many 'satellites' for water-willow *(Justicia)* seen here for the first time (Fig. 12).

The cape-jasmine pollen was taken fresh from the Climatron, whereas the water-willow was collected and dried in Borneo 47 years ago. Both are perfect specimens.

With the advent of the Scanning Electron Microscope, no pollen grain is beyond reach of man. Our larger studies on the classification and evolution of plants will be enhanced as a direct result of this technological advance in the use of electrons.

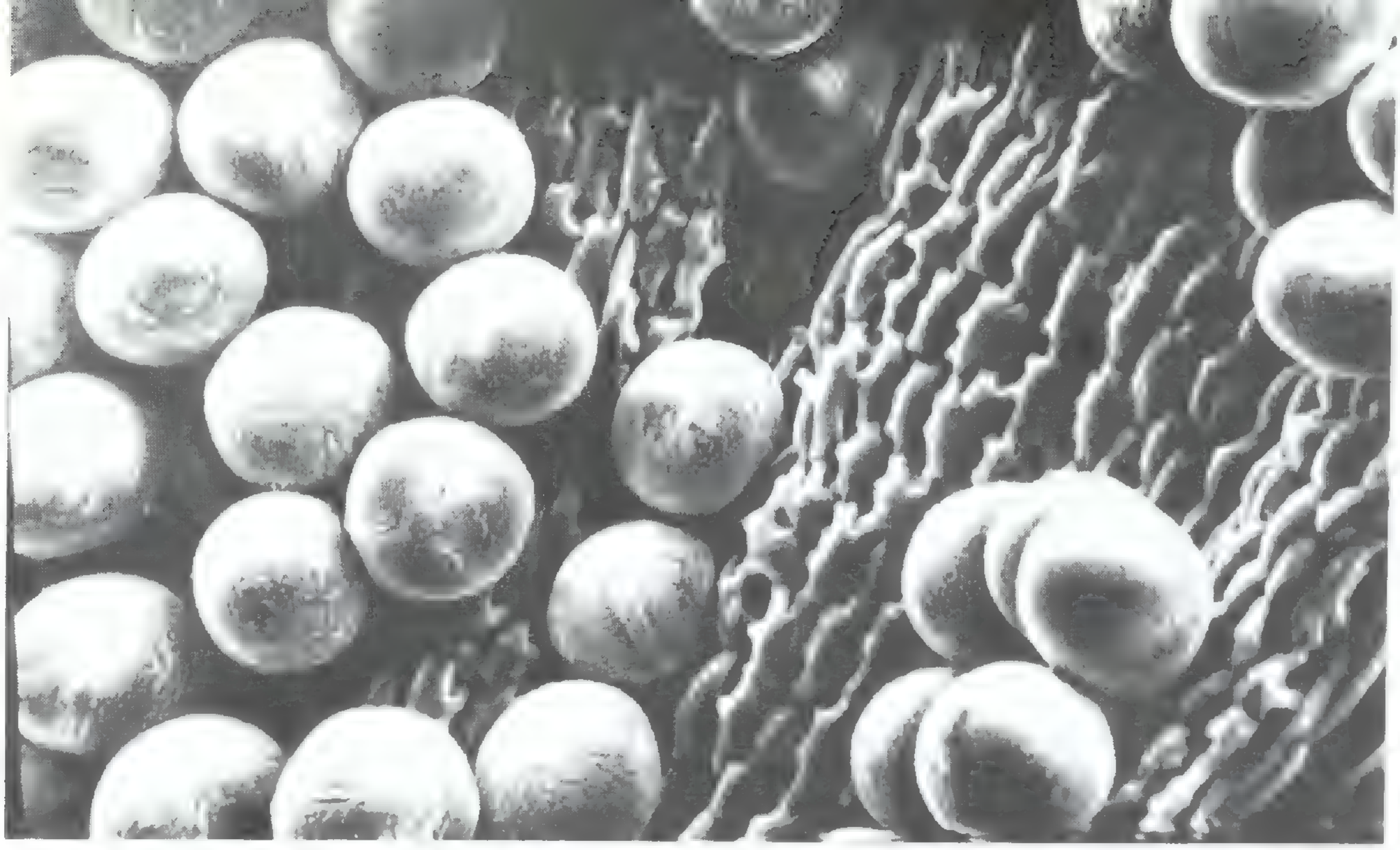

Fig. 2

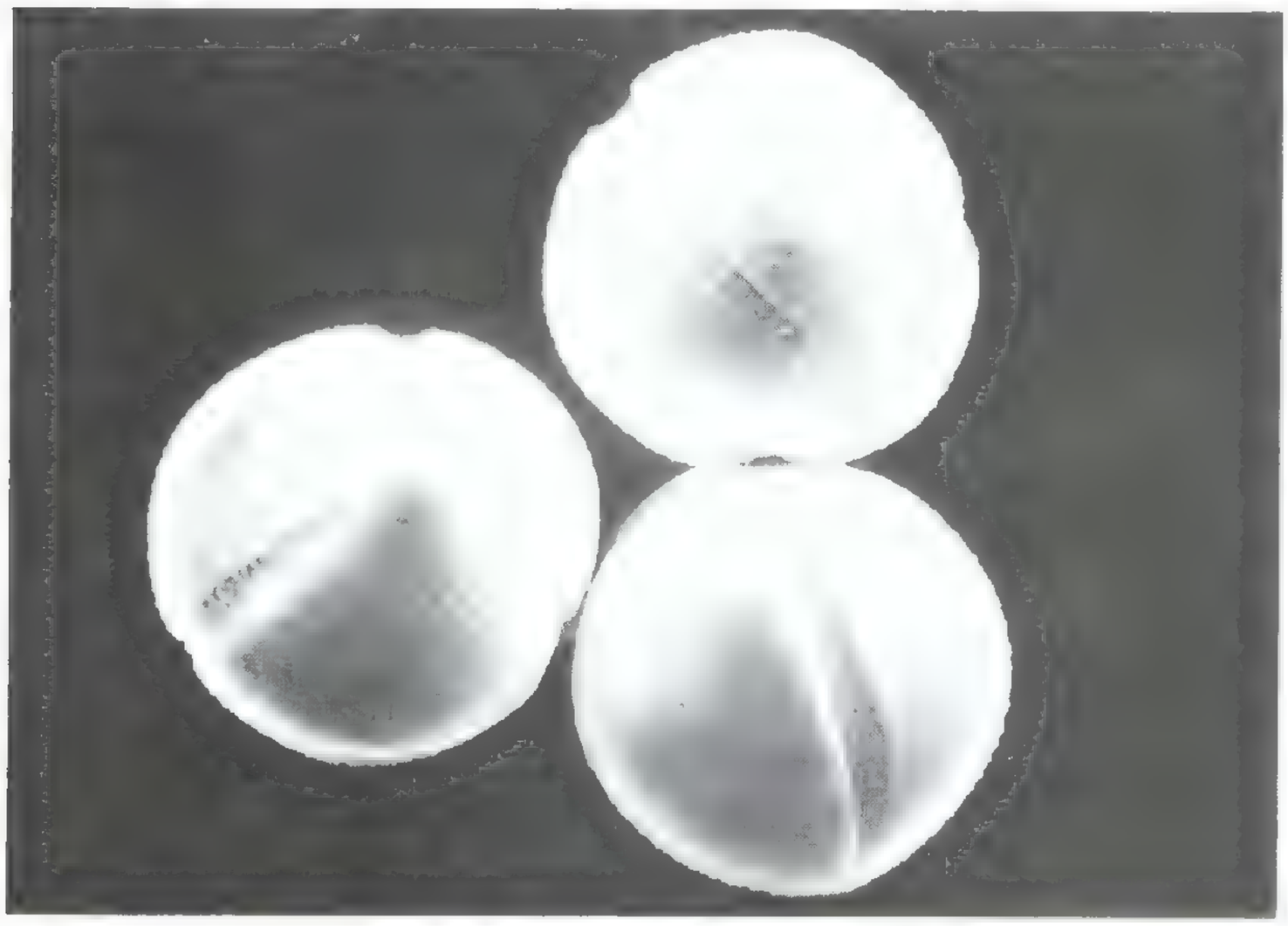

Fig. 3

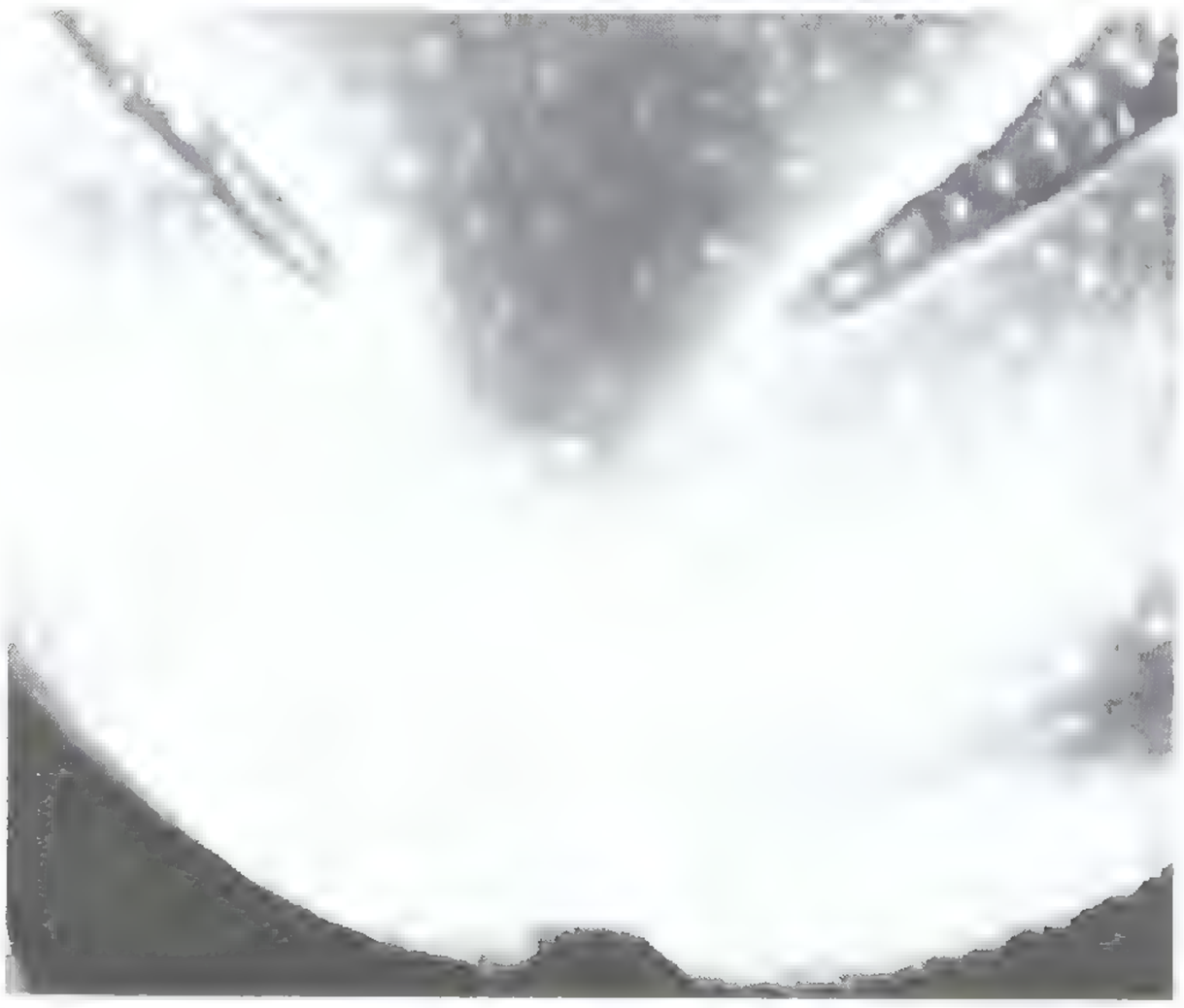

Fig. 4

Fig. 2-4. Pollen grains of *Claytonia virginica L.*, spring beauty, from M.B.G. *(Suda 17)* magnified 507, 954, & 2239 times, respectively. Fresh & nonacetolyzed.

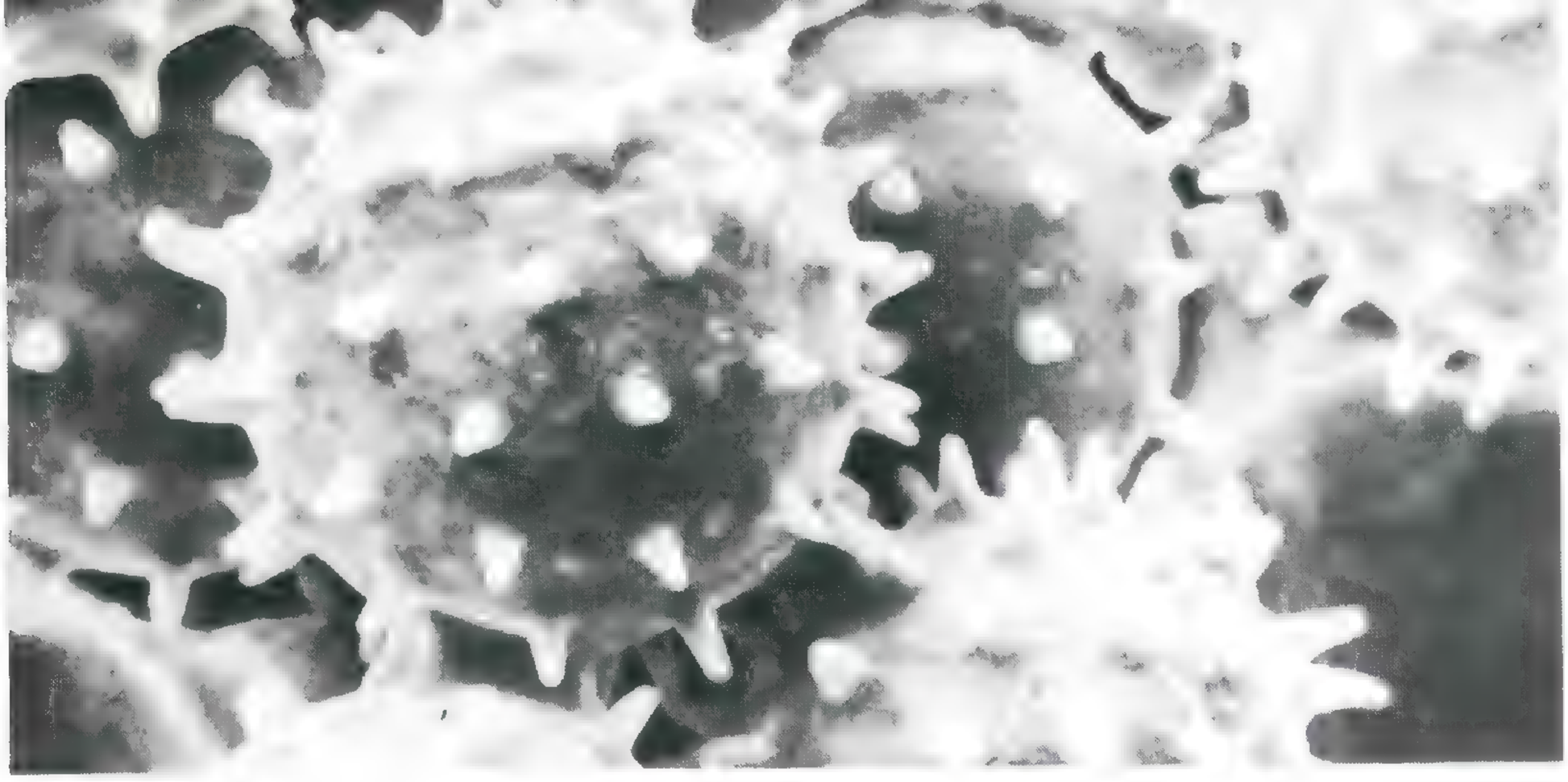

Fig. 5

Fig. 6

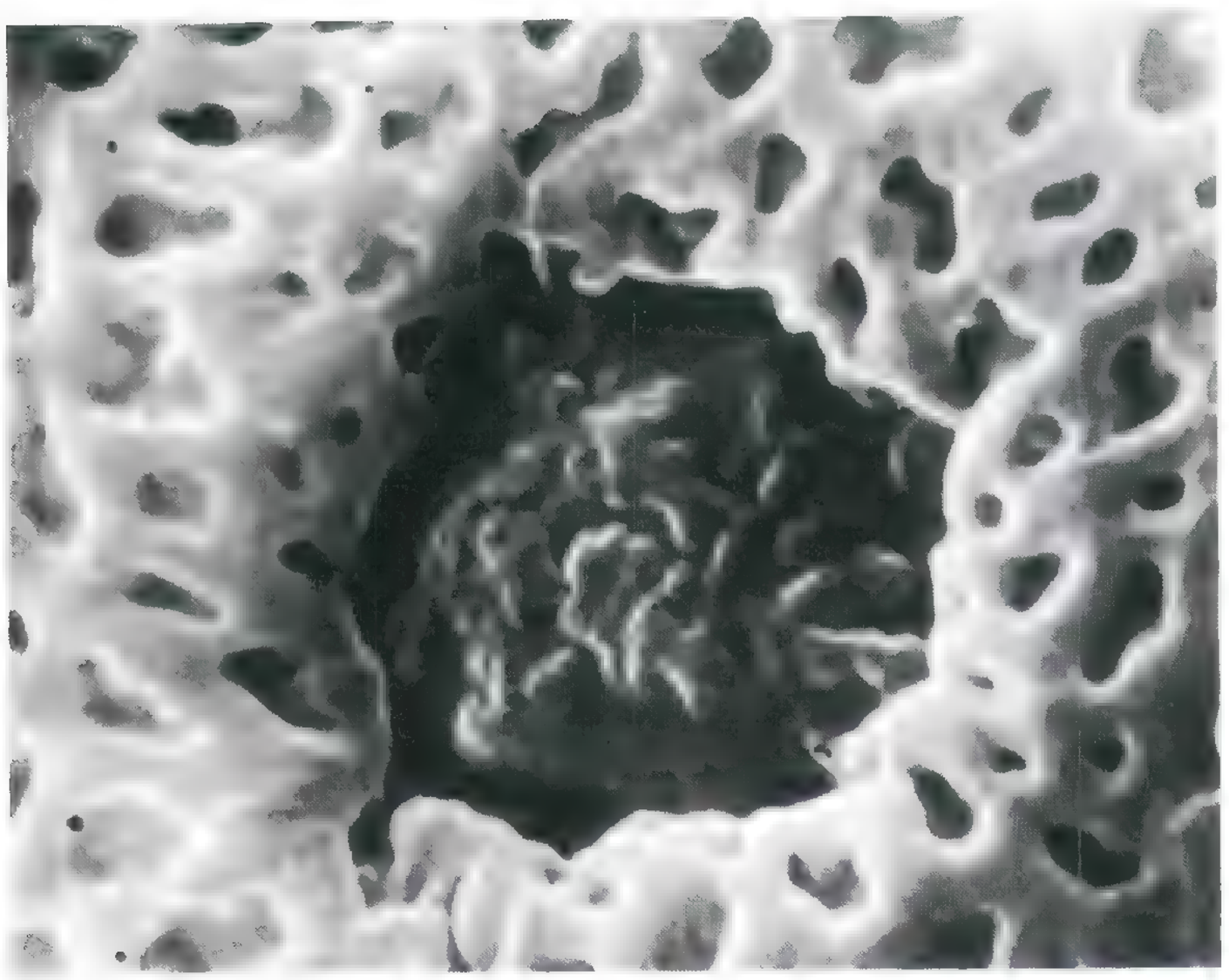

Fig. 7

Fig. 5-7. Pollen grains of *Hibiscus*, aloha hybrid from M.B.G. *(Luikart 11o)* X650, of *Typha domingensis* Pers., cat-tail from the Bahamas *(Lewis 7231)* X1680 & X5675. *Hibiscus* fresh, *Typha* dry, neither acetolyzed.

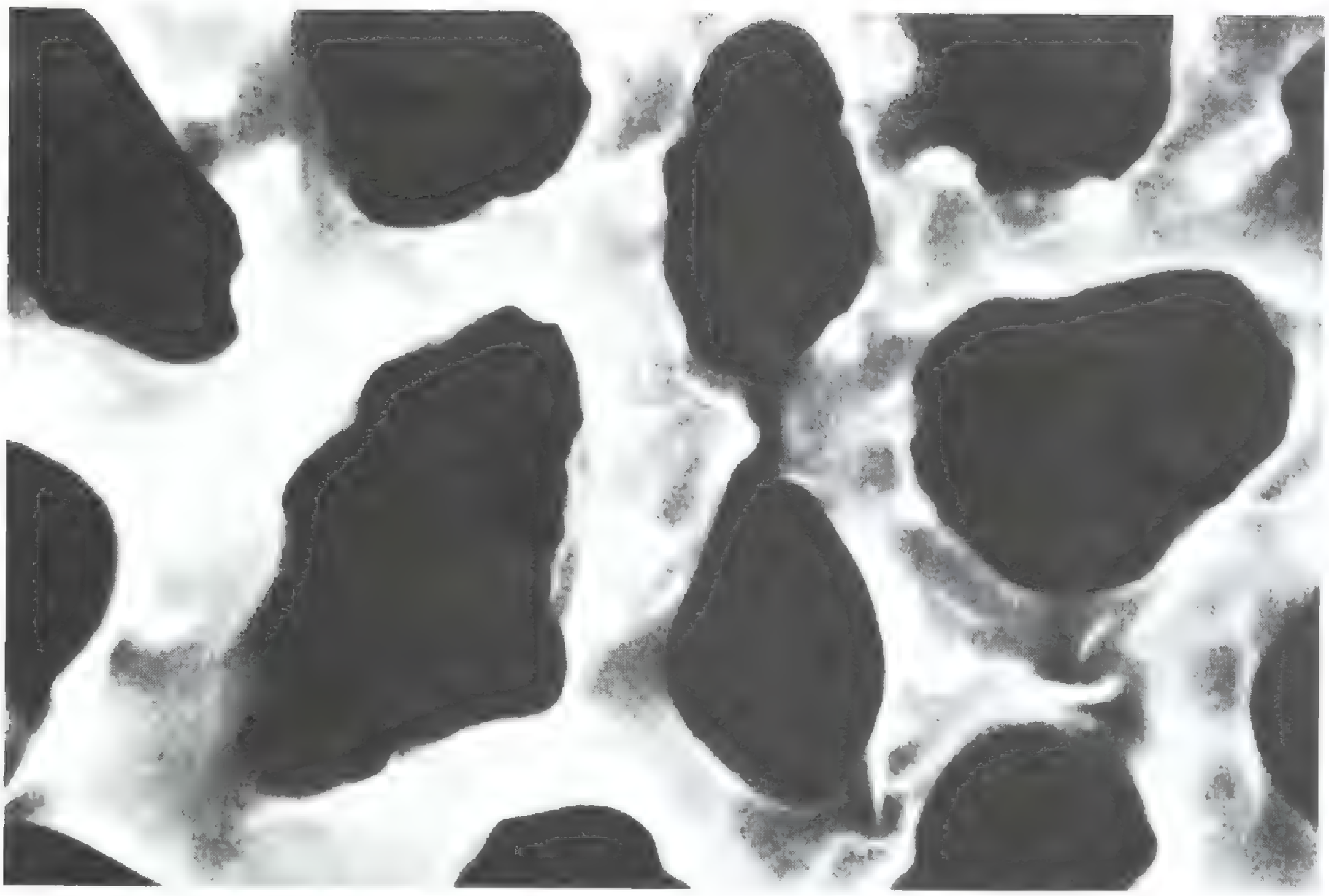

Fig. 8

Fig. 9

Fig. 8-9. Outer pollen walls of *Didymaea mexicana* Hook. f. (top) from Mexico *(Gregory & Eiton 66)* X15,275; of *Linum imbricatum* (Raf.) Shinners (bottom), a Texas flax *(Lewis 7254)* X11,400. Both from dried, acetolyzed material.

Fig. 10

Fig. 11

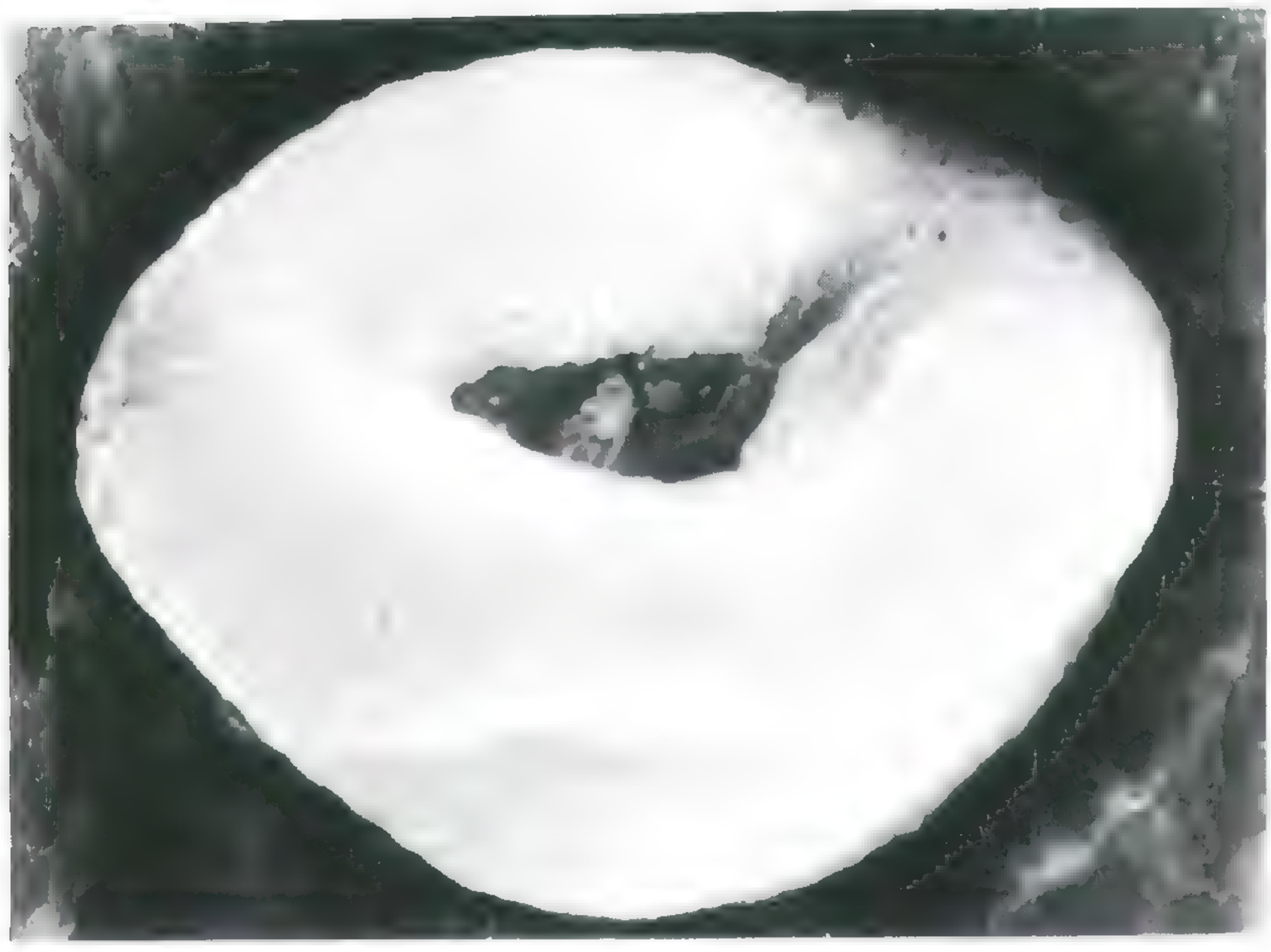

Fig. 12

Fig. 10-12. Pollen grains of *Gardenia jasminoides* Ellis., the cape-jasmine cultivated at M.B.G. *(Luikart 115)* X1500; of *Justicia ptychostoma* Nees, the water-willow from Borneo *(Elmer 20467)* X585; of *Mapouria* sp., Colombia *(Smith 1826)* X2800. *Gardenia* fresh and nonacetolyzed, the others from the herbarium & acetolyzed.

ST. LOUIS LAWNS

Raymond P. Freeborg

The author is Turf Extension Agronomist for the Midwest Regional Turf Foundation and is affiliated with the Department of Agronomy at Purdue University. He was for several years beginning in the early 1960's the Garden's Turf Research Associate, instructing adult grass classes.

THE ESTABLISHMENT and maintenance of a satisfactory lawn in the St. Louis area must be accomplished under a variety of challenging conditions. Environment, selection of grasses, soil, fertilization, watering, and weed control all demand particular attention in a good program of lawn care. In the following discussion we shall identify specific problems related to these factors, and consider the best ways of coping with them.

ENVIRONMENT

The environmental condition to which the grass will be exposed is an important factor in the selection of the kind of grass to be used in a certain area. In a single lawn there are usually several kinds of environment. These may vary from extremely shaded, moist conditions, often found under trees, to extremely hot, dry conditions, found especially on slopes with a south to southwest exposure. Within these two extremes a considerable variety of conditions is possible. As it is impractical to expect a single kind of grass to do well under all conditions, one's choice of grasses should be governed by the conditions peculiar to the area.

SELECTION OF GRASSES

The following summary of grasses, varieties, and areas of adaptation may assist the home owner in making a good selection for his lawn.

COOL SEASON GRASSES
(In order of shade tolerance)

1. Red fescue: This fine leaved grass is one of the most shade tolerant grasses. It should be clearly understood that no grass will grow well in complete shade.

   Red fescue will do best under lower nutrition, and will persist under dry conditions. The more leaf area permitted the plant, the better it can grow, even under adverse conditions.

   Among the newer varieties now available Pennlawn is best adapted to the St. Louis climate. It has good foliage density, will withstand closer clipping, (1-1/2 to 2 inches), and although not immune to leafspot diseases, it will tolerate them. None of the red fescues are adaptable to sunny areas.
2. Bentgrass: The bentgrasses are almost as shade tolerant as the red fescues, and will do best in partial shade. They require good air and water drainage, and the best possible maintenance program if they are to survive in the St. Louis area.

   Diseases that damage bentgrass include large brown patch, leafspot, copper spot, *Pythium* sp., dollar spot, and snow mold. Severe damage from most of these diseases can be prevented with applications every 7 to 14 days of either Kroma Clor, Dyrene, Parzate, or Acti-Dione-Thiram fungicides.

   The two types of bentgrass that are available are the creeping and non-creeping types. The former is used for putting greens on golf courses. The creeping varieties planted on local golf courses include the C-1 (Arlington), C-19 (Congressional), and C-7 (Cohansey). Two varieties that are planted by seed are Penncross and Seaside Bentgrass. The Penncross has been a superior variety of the *seeded* creeping bentgrasses.

   The creeping varieties require an intensive maintenance program, and are not usually recommended for the home owner.

   The non-creeping or colonial bentgrasses include Highland and Astoria varieties. These are the common seeded varieties found in seed mixtures used on the home lawn.
3. Bluegrass: This is the most frequently planted grass in St. Louis. It forms an excellent turf throughout the spring and fall. In summer it becomes partially dormant because of drought and high day and night temperatures. A good fertilizing and watering program will support a fair bluegrass turf even during the hot, dry summers in St. Louis.

Heavy watering should be done only when the bluegrass shows signs of wilt. Bluegrass is beginning to wilt when the leaves start to roll together and the grass has a blue or darker blue-gray color. When watering add approximately 1/4 inch of water. This can be measured by placing several cans within the sprinkler area and observing the depth of water in the cans. When the water has reached the required 1/4 inch depth, change the sprinkler to another location.

Bluegrass should be mowed high enough to enable it to compete with other plants during the summer. This should be 1-1/2 to 2-1/2 inches.

Helminthosporium sp., leafspot, is the most damaging disease on bluegrass turf. This disease is most active during spring and early summer. The grass will appear yellow, with circular brown to dark brown spots on the leaves. As soon as hot, dry conditions prevail the plant dies, leaving irregular circular areas of dead grass on the lawn. If the circular areas appear, the disease damage has been done for that year. The following year a disease prevention program may be started, preferably in early April. Applications should be made every 7 to 14 days, using either Parzate, Kroma Clor, Dyrene, or Acti-Dione-Thiram fungicides. These materials should be used as recommended on the label. This treatment will not completely eliminate the leafspot, but will reduce the severity of disease damage.

Circular spots of dead bluegrass can also be caused by insects such as grubs, cut worm, and sod web worm. Insect damage can be identified by digging into the dead or dying turf to locate the insect. An application of any good insecticide will meet this problem.

Some of the available varieties of bluegrass are Arboretum, Delta, Merion, Newport, Park, and Windsor.

The recent trend in bluegrass planting is to make blends of these varieties. Two of the available blends are:

50% common bluegrass	50% common bluegrass
20% Merion	20% Merion
20% Newport	10% Newport
10% Arboretum	10% Park
	10% Delta

The advantage of blends of this kind is that each variety will be active as the various changes in St.Louis weather encourage

their best qualities. For example, the Merion should be active and green when the Newport is weakened by leafspot, whereas the Newport contributes to good turf when the Merion begins to suffer damage from rust disease.

4. Tall fescue (K-31): Tall fescue will grow under partial shade. It will serve in lawn areas which have some shade, are subject to abuse, and do not require a superior turf.

   This grass should not be used as a part of a fine leaved mixture. It is a perennial, and will persist and grow into large clumps in the lawn. As a weed it is very difficult to eradicate selectively.
5. Red top: Red top is a temporary grass. It is commonly used where a nurse grass is needed to give some cover until the slower germinating, permanent grasses become established. Although usually an annual, it will persist in adapted areas. It is often used as a temporary grass in place of rye grass.
6. Rye grass (domestic): This is also a temporary grass. It sometimes has a tendency to continue as a perennial and form unsightly clumps. Rye grass (perennial): Also a temporary grass in St. Louis, perennial rye grass will give excellent fall and winter color, weather permitting, but it will become unsightly and difficult to mow in summer. It is best used as a temporary planting.

WARM SEASON GRASSES

1. Zoysia: Zoysia develops a tough wear-resistant turf. It will do best under intense sun. There are no severe disease problems, and insects will not cause serious damage.

   The one variety adapted for planting in St. Louis is the Meyer (Z-52) Zoysia which is winter hardy as far north as Chicago. It must be planted by vegetative plantings, (sod, plugs, or sprigs).

   The common seeded Zoysia can be planted in St. Louis, but is difficult to establish and very slow growing. Zoysia seed, (*Zoysia japonica* or *Zoysia matrella*), is expensive and difficult to germinate.

   The home owner should consider planting only zoysia plugs or sod. The sprig method is difficult to use. Plugs of Meyer Zoysia planted every foot in existing grass, in early summer, should give an excellent turf by the end of the following summer if good maintenance has been provided. Good maintenance involves applying about one pound of actual nitrogen per 1,000 square feet every two weeks. Plugs should be mowed or clipped closely, (3/4 inch),

and watered to prevent wilting. A new zoysia planting should be kept moist until new growth is observed.

Established lawns of Meyer Zoysia should be fertilized in late spring, as soon as growth is observed. The old growth and thatch accumulation should be removed at that time. After establishment the zoysia will require a minimum of fertilizing and care. It is an excellent grass for sunny areas in the lawn.

2. Bermuda: Bermuda grass is a good warm season grass and will give an excellent turf under intense sun. It will withstand extended dry periods, and requires very little watering. There is, however, one severe disease that appears in older established turf. It is called "Spring Dead Spot", and appears in late spring as circular areas of dead Bermuda grass.

Of the many varieties, only one is currently adapted for use in St. Louis. This is the U-3 Bermuda grass. It must also be planted as sod, plugs, or sprigs. Early summer planting is important. Planting of sprigs is quite easy. Moisture is required in the early stages of planting, but as new growth emerges, Bermuda grass can survive with limited amounts of water. Feeding, thinning, and mowing procedures should be similar to those employed with Meyer Zoysia.

Bermuda grass can also be purchased as seed. Seed is identified as Common Bermuda Grass. It has a coarser leaf, more open growth, and is more aggressive than the U-3 variety. Either the U-3 or the common variety can become a severe weed for which no good selective control is available. The common variety is not winter hardy, and will persist only in adapted locations. Neither variety should be planted near flower beds or shrubs.

SOIL

The soils found in the St. Louis area provide another challenge to the home owner who is interested in his lawn. These soils are of secondary value and usually poor.

It is generally not practical for the home owner to attempt to modify or correct a poor soil condition except in small areas where specific problems such as extreme compaction or poor drainage exist. Large volumes of sand or organic matter would be necessary to modify the soil. Small quantities, particularly of sand, can increase the severity of the problems rather than correct them.

The best contributor to organic matter in the soil is the accumula-

tion of old root, stem, and leaf tissue naturally contributed. The lawn acquires these adequate quantities of organic matter over the years with the buildup of organic matter and associated soil microorganisms. For this reason additions of peat to build up soil organic matter are most important only when a new lawn is being established.

A reasonable management program including selection of proper grasses, adequate fertilizer, proper watering, thatching, and patience is necessary for the establishment of a good turf. This procedure will eventually make a fair soil of the basically poor soil with which we must contend.

FERTILIZATION

A good program of fertilization is necessary to establish a new lawn as well as to maintain an established turf. The home owner can best discover a program suitable for his lawn by first having a soil test analysis made. The test will indicate whether the soil is alkaline or acid.

An acid soil requires applications of lime. The alkaline soil needs sulfur bearing fertilizers. Soils in the St. Louis area are usually found to be acid rather than alkaline.

Nitrogen is a very important element for the growth of a good lawn. A soil test will not adequately indicate nitrogen requirements. The best test for nitrogen is to observe the growth and color of the lawn. If the grass stops growing and becomes yellow-green, it can often be attributed to a need for additional nitrogen. An approximate rate for nitrogen applications each year would be from 2 to 4 lbs. of actual nitrogen per 1,000 square feet, per season.

The amount of nitrogen required could vary with the type of grass, the stage of development of the lawn, and the season. In a cool, wet summer there may be a need for additional nitrogen. In a hot, wet summer the additional nitrogen should not be added. Too much growth from applications of nitrogen make the grass more susceptible to disease. Wilt is often encouraged by excess nitrogen applications in hot, dry weather.

Applications of nitrogen should be made with caution. If applied at too high a rate and without thorough watering nitrogen can burn the grass severely. This is especially true of the cool season grasses. Warm season grasses are not so severely burned by nitrogen, but caution should still be used in its application. It is advisable to use

the better quality fertilizers which now contain nitrogen in a form that reduces the hazard of burning.

Phosphate and potash fertilizers are also very important in the establishment of a good turf. Mixed fertilizers are available in many combinations of nitrogen, phosphate, and potash. Recommended blends of these three elements are in ratios of 3-1-2, 3-1-1, or 2-1-1.

Organic fertilizers such as sewage sludge, castor bean pomace, cotton seed meal, or soy bean hulls can also be used. These can be applied safely during the hot summer periods when there is danger of burning from inorganic forms of fertilizer.

WATERING

One of the most difficult things to learn for good lawn maintenance is proper watering procedure. Certain fundamental principles should be observed.

Attempt to maintain moisture throughout the soil constantly to a depth of at least 4 to 6 inches. Avoid saturating the soil surface with too much water as is often done with frequent light surface watering.

Water deeply and less frequently.

When watering deeply, permit sprinklers to operate until constant surface run-off water is observed. Then either move the sprinklers to another location or shut them off for a short period. After the first application has had time to soak into the soil, turn sprinklers on again. Continue in this manner until there is adequate moisture in the soil.

It is often desirable to water in the early afternoon. It is important that the grass never be watered so heavily that water will remain on the soil surface at mid-day. Afternoon watering is sometimes beneficial in cooling the grass. It is only for cooling or for wilt reduction that a light surface watering is acceptable.

Bluegrass is also susceptible to wilt from late morning to early afternoon. The leaves will begin to turn blue-gray, and the grass will feel unusually hot to the touch. A moderate watering at the time this condition is observed will prevent considerable damage to bluegrass. Often some of the best bluegrass lawns are thinned by wilting. Wilting usually appears in isolated spots on the lawn, such as slopes or hard to wet ridges. Hand watering in these isolated spots, when wilt is observed, will save the grass.

WEED CONTROL

Another challenge to be met in the home lawn is that of weeds. In the summary which follows you will find listed the weeds which commonly appear in the home lawn, and the means with which they can be controlled.

1. Broad leaved summer annual weeds: Dandelion, plantain, dock (young plants), knotweed (young plants), ground ivy, and smart weed can be controlled by 2, 4-D.

   Sheep sorrel (red sorrel), chickweed, clover, knotweed, bindweed, thistle, spurge, and henbit can be controlled with MCPP, Mecopex, or Banvel D.

2. Summer annual grass weeds: Crabgrass, after germination but before full growth of seedlings, can be controlled easily with pre-emergent herbicides such as Pre San, Tupersan, Balan, Dacthal, Chip-Cal (calcium arsenate), and Chlordane.

   In its post emergent stage, or after sprouting, crabgrass is controlled with disodium methyl arsonate, or amine methyl arsonate. Young foxtail nut grass, and barnyard grass are also controlled by the arsonates.

Time of application of all pre-emergents is very important. The Chlordane and Dacthal should not be applied until about mid-April in St. Louis. As there is limited residual control from these two materials, application should be made just prior to crabgrass germination. The full recommended rate should be applied yearly to get good crabgrass control.

Pre San and Balan have about 50% residual control, and will give some pre-emergent control the following year. At least one half the recommended rate should be applied yearly following the original full rate application.

Chip-Cal (calcium Arsenate) has about 75% residual and would require additional yearly applications of one-fourth the recommended rate following the original full rate application. This material will also control chickweed and *Poa annua*.

Silver crabgrass or goosegrass in the pre-emergent stage can be well controlled by Pre San. Apply in spring, about April 15 to May 1 at rates recommended on the label, and water in thoroughly.

Addition of one-half the recommended rate of 2, 4-D to either DSMA or AMA will improve weed control. This combination

will control young goosegrass as well as summer annual grasses, and broad leaved weeds.

For the best post emergent crabgrass control there must be adequate moisture in the ground. Water the lawn thoroughly before making the first application of DSMA or AMA. Within 24 hours after the first application, water the area again. Repeat this procedure in 5 to 7 days to accomplish complete control of the crabgrass.

3. Fall and Winter Annual Grass Weeds: Pre San and Chip-Cal are quite effective for pre-emergent control of *Poa annua*, annual bluegrass. Apply after August 1, and before August 15, for fall pre-emergent control. It may be necessary to apply the pre-emergent again about April 1, for spring *Poa annua* control.
4. Miscellaneous Weeds: Nimblewill is a grass often confused with bermuda grass, bentgrass, or crabgrass. It is a summer weed, becoming dormant in fall resulting in straw colored spots in bluegrass lawns.

There is no good selective control for this weed. Control is limited to complete eradication of all existing growth with a non-selective herbicide such as Sodium Arsenite.

The bermuda grass, mostly the common seeded variety, is a very difficult weed to eradicate because the rhizomes are buried so deeply in the soil as to be out of reach of most herbicides. One of the grass controls available to the home owner is Dowpon (Dalapon). It is recommended for deep rooted grass control. It will kill all grasses indiscriminately and will inactivate the soil for an extended period, often for the entire planting season. Sometimes it is necessary to make two or three applications in spring, summer, and late summer, to control bermuda grass.

Moisture is very important to the success of any weed control program. With adequate moisture, weeds will be growing actively, and thus be more susceptible to herbicides. The moisture in the soil will also help protect the desirable grasses.

Temperature at time of application is also an important factor. With most selective herbicides a reduced rate of application is recommended as the temperature increases. The air temperatures should be from 70° to 80°F to encourage active plant growth for best weed control. If the temperature is above 85°F the herbicides will become

more efficient, but will also be more damaging to the desirable grasses.

Weed killers should always be used with caution. Read the label and use only the recommended rates and procedures. The 2, 4-D, 2, 4, 5-TP, Silvex, and Banvel D (Dicamba) can damage trees, shrubs, and flowering plants. When using these be very careful to avoid drifting of the spray onto other desirable broad leaved plants. It is also extremely important that the sprayer be thoroughly cleaned after using these herbicides before using the sprayer to apply other materials.

Obviously the attractive, reasonably healthy lawn in the St. Louis area is the result of great patience, effort and vigilance on the part of the home owner. Scientific research is constantly at work to make this an easier and more rewarding task, but there are still unsolved problems or partially solved problems. The home owner with a lawn that his neighbors admire deserves to enjoy a feeling of accomplishment and personal satisfaction. His has been no mean feat.

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MISSOURI BOTANICAL GARDEN

BULLETIN

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NOVEMBER-DECEMBER 1969

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From the Director

PEOPLE are rapidly becoming aware of the fact that the Earth is a very limited piece of real estate and that its soil surface, its water, and its sky are not boundless voids into which garbage, effluents, and various other wastes can be dumped indefinitely. Man, the consumer, is the most prolific converter of resources to waste products the Earth has ever had.

Civic and political leaders are deeply concerned. Last year the U.S. House of Representatives and the U.S. Senate held a joint Colloquium on the Environment. I was a participant in those discussions. During the year Congressman Richard Ottinger (New York State) established in Washington, D.C. the Environmental Clearing House, a group of Ad Hoc advisors available to the Congress. Approximately 120 scientists, social scientists, and economists are members of this advisory group of which I am the Chairman and Frank Potter is the Executive Secretary in Washington, D.C.

Many Congressmen are introducing legislation concerned with pollution, the environment, conservation, and related matters. The Environmental Clearing House gives the Congressmen a stable of experts who can testify on these issues when necessary. The advice of these experts has been used frequently by the members of Congress. It is encouraging that so much concern with environmental matters is being shown by members of Congress.

Only by means of wise legislation, with the cooperation of a concerned public, and with the leadership of industry can this nation maintain a high standard of living within a clean, healthy environment for many generations in the future. You can help to achieve these goals by placing your individual convictions before your representatives in Congress and your civic and industrial leaders at home.

David M. Gates

MISSOURI BOTANICAL GARDEN BULLETIN

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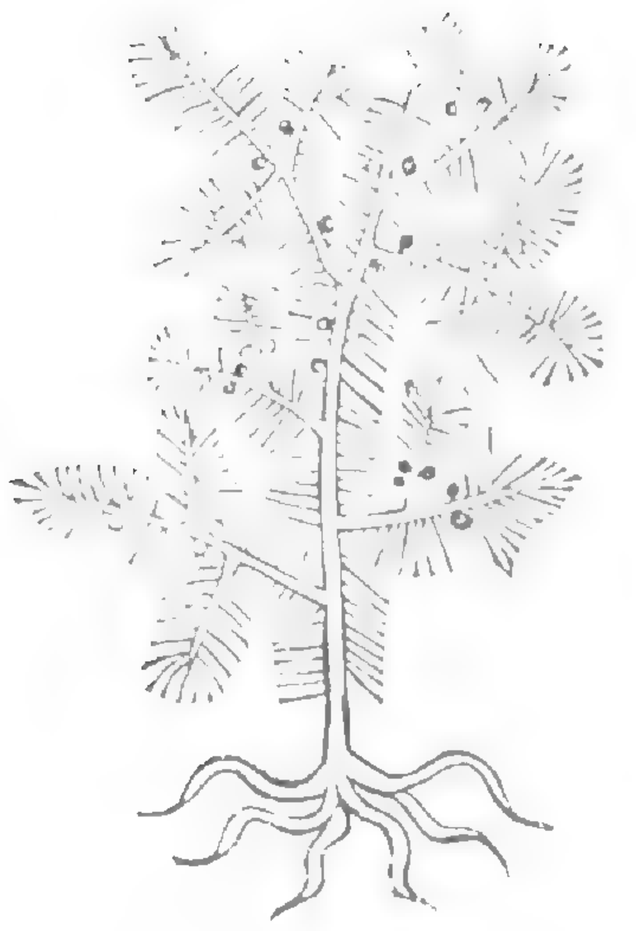
Cover design by Peter Geist.
Illustration is from a woodcut of a juniper tree *(Juniperus* genus*)* in the *Latin Herbarius* printed by Peter Schöffer in Mainz in 1484.

JUNIPER (cover)

Carla Lange



THE ILLUSTRATION on the cover of this issue of the Bulletin is a copy of a wood-cut in Peter Schöffer's *Latin herbarius,* printed in 1834, of *Juniperus,* an evergreen, which as the late Dr. Edgar Anderson wrote in the last number of the Bulletin for 1967, "was the commonest Christmas tree in St. Louis for many years. It is still for many Missourians the tree they will see in grandma's living room if they go home for the holiday." He was referring to the American species *Juniperus virginiana.*

One of the characteristics of the juniper trees is that they have needles throughout life. The wood is said to last a hundred years; the chemists add that a coal of juniper, covered with ashes of the same kind, will keep on a fire for an entire year.

The most striking fact concerning the common juniper is the enormous area over which it is spread. On the eastern continent it is distributed over the whole of Europe and Asia, north of and including great mountain chains extending eastwards from Spain to China, and restricted northwards only by the limits imposed by climate on arborescent vegetation, and excluding the steppe and desert regions of south-east Europe and Central Asia. In the United States its range northwards is restricted by the same cause as on the eastern continent, while southwards it spreads on the Atlantic side to the highlands of Pennsylvania; in the central region to northern Nebraska and along the Rocky Mountains to Arizona, New Mexico and western Texas; and on the Pacific side from Alaska to northern California.

In India the twigs are burned as incense and in the higher Himalayan passes, the wood is used for fuel.

The berries of the juniper tree are extensively used and when crushed and distilled yield an essential oil. According to John Parkinson's herbal, *Theatrum botanicum: The theater of plants or an herball of a large extent*, published in London in 1640, "The leaves and young tender branches of the Juniper tree, or the juice of them, or of the berries themselves taken in wine, are very effectuall against the biting of a Viper or Adder, as also against the Plague or Pestilence or any other infection or poyson: and are likewise profitable for the cough and shortnesse of breath, and other diseases of the Chest and Lungs. The berries are very comfortable to the brain and strengthen the memory and sight and all the senses and the heart also. The salt made of the ashes of the juniper wood is a singular remedy for the Scurvey. The smoke of juniper wood being burned, besides that it yieldeth a good scent to perfume any house, is of good use in the time of infection and drives away all noysome Serpents, Flies, Waspes and the ashes of the wood or barke made into a Lye with water doth cure all itches, scabbes pustules or other eruptions in the skinne."

In Europe, during the middle ages, the smoke of the burned juniper berries was used to cleanse the air in houses of pestilence. It was also believed that chewing the berries would protect against any contagious diseases.

Considering the wide use of the juniper, it is not astonishing to learn that a great deal of superstition was connected with it. It was believed that it would drive away evil spirits, that the smoke of the burning wood would drive away witches and prevent being haunted by the devil and other wicked ghosts.

* * *

The Partnership of Hollies and Birds

There is a natural relationship between spiny or thorny evergreens such as a red cedar or a holly and the small birds that roost in their branches during cold winter nights. The birds have shelter from the cold and protection from hawks and owls. The evergreens have the advantage of the bird droppings which wash off with the snows and rains and fertilize the tree. Hollies in particular are strong feeders; they grow their best in very rich soil. By scattering bird seed at the base of holly bushes one encourages bird visitors and indirectly brings the hollies the fertilizer which is best for them.

E.A.

GARDENING IN ST. LOUIS

NOVEMBER and DECEMBER

ONCE AGAIN the gardener's focus turns to inside projects. The outdoor season is over except for cleaning up frozen tops of plants and protecting perennials, trees, and shrubs for winter. All fall planting should be completed by now.

Plan on avoiding winter doldrums by doing some serious indoor gardening. It's amazing how well house plants will do with a bit of conscientious care, such as regular watering, a bit of fertilizer, and repotting when necessary.

Plant paperwhite narcissus bulbs inside by mid-November and have Christmas bloom. Keep pots at room temperature for about a week, then store in the dark at about 50° till three weeks before flowers are wanted. (Friends of the Garden may obtain instructions on forcing paperwhite narcissus bulbs by sending a self-addressed envelope to the Education Department.)

Rake leaves as necessary and use all this wonderful organic matter for mulch and compost. Water tulip and daffodil beds, as well as perennials and shrubs, if the ground is dry and not frozen. Move tender perennials into a cold frame. Protect trunks of newly planted small diameter trees with a commercial tree-wrap tape.

Lawns and established shrubs and trees can be fertilized now so that nutrients are available when needed. Fall fertilized lawns green up faster and grow better than those fertilized in the spring.

Clean, repair, and store gardening tools. Be sure to drain garden hoses. Wipe the blades of shovels and trowels with a lightly oiled cloth to deter rusting.

Use ammonium sulfate to melt ice on walks and drive as it won't harm grass or shrubs and trees as salt does.

A small investment in suet, seed, and peanut butter will bring great rewards by attracting handsome winter birds.

BOTANY OF A FRUITCAKE

Mary A. Gamble

Inspiration: Hugh Cutler
Recipes and Cake: Virginia P. Schreiber

THE BOTANY of a fruitcake is as rich, complex and intriguing as its taste. The latter can be achieved only by the masterful blending of the odors, flavors, and textures of a wide and extravagant assemblage of "botanicals" whose habitats range the world, from the tropical Spice Islands to the temperate Corn Belt. For a truly great fruitcake, there can be no scrimping. The botanical roster of the two superb recipes given includes 12 families: *Bromeliaceae, Gramineae, Juglandaceae, Lauraceae, Lecythidaceae, Myristicaceae, Myrtaceae, Orchidaceae, Palmae, Rosaceae, Rutaceae,* and *Vitaceae;* 15 genera, 18 species, and an indeterminate number of varieties.

Most exotic of the fruitcake botanicals is the VANILLA bean, fruit of *Vanilla planifolia,* a vine orchid *(Orchidaceae)* indigenous to southwestern Mexico. Hernando Cortez tasted the warmly pungent flavor of vanilla in 1560 at Montezuma's court; in Spain it was an instant hit. Efforts to produce the bean in European tropical and subtropical colonies failed until about 1835 when a French botanist

discovered that only the small *Melipona* bee of Mexico could infiltrate the labyrinthine vanilla blossom to pollinate it. Artificial pollination succeeded; today the bean is produced in Madagascar, Tahiti, Java, etc. The long green bean acquires its chocolate brown color and spicy fragrance in a six-week curing process of sweating and drying. Mrs. Schreiber makes "vanilla sugar" for her cakes by placing a split dried bean in an airtight container of sugar (1 bean per 2 lbs.) for several weeks.

The SUGAR flavored by the vanilla was refined in the continental U.S. from raw sugar milled from sugar cane *(Saccharum officinarum)* grown on the coastal plains of Hawaii's four largest islands. It was bred specifically, through continuing industry programs, for the soil, altitude, and climatic conditions in which it is grown. Sugar cane is a giant-stemmed perennial grass *(Gramineae)* that grows from

This is the golden fruitcake, made for the occasion by Mrs. J. Glennon Schreiber, who supplied the family recipes, enriched over the generations, for both it and the "black" cake. It contains 15 ingredients of botanical origin and is encircled with a holiday garland of the glossy, deep green leaves of Burford holly *(Ilex cornuta Burfordii)*. The photograph, in its setting in the north twin parlor of Tower Grove House, was made by Claude Johnston, staff photographer and grower.

8 to 24 feet high. It is propagated by seeding the fields in furrows with short sections of freshly cut stalks containing several joints, each with a dormant eye. It takes 2,000 pounds of water to produce one pound of sugar (53% of Hawaii's fields are irrigated); 100 pounds of milled cane produce 12 pounds of raw sugar from which 11.5 pounds of pure sugar are obtained. Brown sugar is produced by changes in the refining process. Capt. James Cook saw sugar cane growing wild in Hawaii in 1778; historians believe it reached the Islands from the remote South Pacific about the year 500 A.D.

The fine white all-purpose FLOUR used in the cakes is made of common or bread wheat *(Triticum aestivum)*, an annual or biennial grass *(Gramineae)* and most important of the five wheat species recognized by Linnaeus. Hard red spring, hard red winter (these may be the same varieties planted according to locale), and hard white wheats, individually or blended, are milled into bread flour; sometimes just a "touch" of soft red winter wheat is added to achieve the best all-purpose flour. These blends, with exact varieties and percentages, are trade secrets.

About seven-eighths of the U.S. wheat crop is fall-sown. Wheat, exacting as to soil and climate, generally is considered a cool weather plant. In the U.S. hard red winter wheat is grown principally in the southern Great Plains, hard red spring wheat in the northern Great Plains, white wheat in the Northwest, and soft red winter wheat in the North Central states. Wheat crops and quality vary with the season; sources for quality flour follow the annual production pattern. Wheat, possibly the first grain domesticated by man, was initially cultivated in the Mediterranean area and came to the New World with the Spaniards in 1493.

The ground CINNAMON in the "black" cake is the Saigon variety, called "Cassia" in the spice trade and just plain "cinnamon" generally. It is made from the dried bark of the evergreen cassia-bark-tree *(Cinnamomum cassia)*, native to China and cultivated in Indo-China and Indonesia; most of the cinnamon we use today comes from Indonesia. Ceylon cinnamon *(C. zeylanicum)*, called "true" cinnamon, is native to Ceylon, India and the Malabar coast. It is paler in color and milder in taste than the Saigon which has the ruddy color, bittersweet aroma, and warm and pungent flavor preferred by most Americans. The cinnamon tree belongs to the *Lauraceae* family. In its wild state it resembles the bay or sweet laurel, but

as cultivated it is pruned so severely it looks like a shrub, the trunks being pollarded to form stools from which young shoots grow. These shoots are harvested and the bark peeled and dried. Arabian traders brought cinnamon along their secret caravan routes to the Romans who dedicated it to their god of commerce, Mercury.

The 12 to 20 foot evergreen clove tree *(Eugenia caryophyllus)* produces in its dried, unopened flower buds the spice we know as CLOVES. A 17th century European, living in the tree's native Moluccas or Spice Islands, described it as "the most beautiful, elegant and precious of all known trees." It belongs to the *Myrtaceae* family. Cloves reached Europe, via India, late in the 2nd century, but remained so expensive for centuries that only the very rich could afford them. Hand harvesting of the flower heads begins in July. The buds must be dried quickly until the characteristic reddish brown color is achieved.

Both NUTMEG and MACE are produced from the fruit of the tropical nutmeg tree *(Myristica fragrans)*, the only example of two spices occurring naturally on the same fruit. The nutmeg is the dried seed found inside the kernel; mace is the skin which covers the seed. The nutmeg, native to the Spice Islands, is a tall, bushy evergreen of the *Myristicaceae* family. Mature trees produce from 1,500 to 2,000 nuts annually. Today they grow in tropical areas of both hemispheres, doing best in rich soil near the sea. The ripened fruits are a pale orange-yellow. They are gathered with long poles with baskets attached and sun-dried until they rattle in their shells. Mace is a vivid red which fades to a light orange in drying; irregular pieces are called blade mace, the pulverized ground mace. The "wooden nutmeg" was a bit of early Yankee trading chicanery.

ALLSPICE is the dried, green, pea-sized fruit of a beautiful 25 to 40 foot tropical evergreen tree *(Pimenta dioica)*, native to the western hemisphere and member of the *Myrtaceae* family. It is the only major spice grown on this side of the world, a major source being Jamaica. The berries, picked while green, are sun-dried to a dark, reddish brown. Their aroma and flavor are like those of cinnamon, cloves, and nutmeg combined, hence the name allspice.

The SHERRY used in the golden fruitcake is made of fully-ripened California grapes, grown in one of the state's vineyard areas where soil and climate are much like those of European districts where *Vitis vinifera (Vitaceae)* has thrived for millennia. The Euro-

pean origin grapes are grafted on native American root stock because it is resistant to *Phylloxera*, a plant louse which attacks leaves and roots of grape vines.

Sherry is a blend of grape wines. Usually from 4 to 6 varieties are used, choice and percentage varying with the wine maker. Some varieties preferred are Palomina, Emperor, Tokay Flame, Malaga, Fahrer Szages, Pedro Ximines, Thompson Seedless, Mission, the last being a descendant of grapes brought from Spain to Mexico beginning in Cortez' time, and planted in California by the Franciscan fathers when they established both missions and vineyards along *El Camino Real* in the 18th century. The pleasing "nutty" flavor, the bouquet, and the pale to dark amber color of sherry depend principally on the baking process and other cellar operations. The name sherry is the Anglicizing of *Jerez*, sherry-producing district of Spain. BRANDY, recommended to "cure" the golden cake, is 80-100 proof spirit produced from wine; favored brandy grapes are Thompson Seedless and Flame Tokay.

All of the RAISINS in the U.S. are produced from grapes grown in the San Joaquin Valley of California where the long, hot summers provide the exact climate needed to turn a grape into a raisin through drying it in the sun. Ninety-five per cent of the raisins are now made from one variety of grapes, the Thompson Seedless, named for its grower. The first California raisins were produced in 1873, result of a *very* hot summer when grapes dried on the vines. An enterprising pioneer grower sent his harvest to San Francisco where a grocer friend, inspired by a ship from Peru in the harbor, quickly sold them as "Peruvian delicacies." Today three varieties, in addition to Thompson Seedless, are used for raisins: Muscat, Sultanina, and Zante Currant.

The fully ripened, hand-picked grapes are placed on paper trays between the vineyard rows to dry for 2 to 4 weeks, being turned once, and acquiring the characteristic brownish-purple raisin color. White raisins are produced from the same grapes by a special processing immediately after picking, an artificial dehydration which includes the use of sulfur dioxide. The CURRANT raisin is produced from the Zante Currant grape, approximately 1/4 the size of a Thompson Seedless. Raisins have been relished for thousands of years. Nero served them at his banquets; Cleopatra fed them to Mark Antony.

The slivered ALMONDS in the recipes were grown in California, now the world's largest almond source. In the Almond Belt more than 165,000 acres are planted to some seven major varieties: Nopareil (almost 50% of the crop), Mission, IXL, NePlus, Peerless, Drake, and Jordanola. Almonds are also grown commercially in Italy, Spain, Portugal, Morocco and Iran, principally as a cottage type industry with small plantings. In California harvesting and processing have become mechanized with resulting increased production and quality control. The almond tree *(Prunus amygdalus)* is, like the cherry, one of the stone fruits, a member of the *Rosaceae* family. Probably native to western Asia, it was brought to California by the Franciscan fathers. It resembles the peach tree but is larger, longer-lived and even more beautiful in bloom. The maturing fruit is a dull grey; when ripened the leathery hull opens and the nut falls. Propagation is by budding on seedlings of either soft or hard shell kinds.

The BRAZIL NUT is the triangular, smoothly edible seed of a large South American tree *(Bertholletia excelsa)*. The hard-shelled, globular fruit, from 4 to 6 inches in diameter, contains from 8 to 24 seeds arranged in sections like an orange. The tree *(Lecythidaceae family)* grows in Brazil, Venezuela, and the Guiana region.

The PECANS most used in fruitcakes are the small, rich, sweet-flavored nuts from native seedlings, commercially described as "medium halves." The pecan *(Carya pecan)* is a member of the walnut *(Juglandaceae)* family, indigenous to the lower Mississippi Valley, and grown through the southern tier of states from North Carolina to New Mexico. The crop varies widely from year to year, depending partly on the weather and partly on the tree's tendency to produce biennially. As in wheat, sources depend on local or area growing conditions. The seedling groves are found on the alluvial plains of the principal rivers. The improved varieties generally are propagated by whip grafts on a disease-resistant variety of seedling. The U.S. Department of Agriculture maintains a pecan breeding program to develop pecans suitable for specific areas and uses. Georgia, Texas, Alabama, Mississippi, and Louisiana are important producers. Some of the better known improved varieties often chosen to decorate cake tops, are Stuart, Schley, Success, Burkett, Desirable, and Elliott.

COCONUT is the fruit of the monotypic coconut palm *(Cocos*

nucifera), probably of Asiatic or Polynesian origin and dispersed throughout the tropics by ocean currents. This romantic and lofty tree *(Palmae* family*)* is grown only from seeds; it may, from maturity, yield 75 or more nuts annually. It grows best on the seashore where, swaying in the balmy breezes, it long has symbolized escapism.

The red and green dyed candied CHERRIES in the cakes are sour cherries *(Prunus cerasus)*, the most important commercial species in the U.S. Sour cherries with colorless juice are Amarelles, of which Montmorency is the most popular variety; those with reddish juice are Morellos. The sour cherry is believed native to the Caspian and eastern European areas. Its successful culture depends more upon climate than soil, the flower buds being susceptible to cold. New York, Michigan, Wisconsin, Ohio and Pennsylvania are leading producers. Propagation is by budding on seedling stock of Mazzard (wild sweet cherry) or Mahaleb, an inedible sour species from Eurasia. Yield may run 15 to 40 quarts a tree.

The PINEAPPLE *(Ananus comosus)* in the recipe is the smooth, Cayenne variety most used for canning. The plant is believed native to Central and South America; Christopher Columbus saw it growing on Guadaloupe Island in 1493. Because it can be kept out of the ground for months yet still will grow when set into moist soil, it was comparatively easy for the explorers of the Great Age of Discovery in the 16th and 17th centuries to carry the pineapple to India, Africa, and Asia. Commercial propagation is by ratoons or suckers, stem and fruit slips, or cut-up stumps of plants, the last being handled like potatoes. The Cayenne reached Hawaii from French Guiana via England in the early 20th century. Pineapple, a bromeliad *(Bromeliaceae)*, needs little water; in Hawaii it is grown in semiarid, otherwise unproductive areas. It requires heavy fertilization. Fields are mulched with asphalt-impregnated paper through which plants are set at the rate of 15 to 20 thousand an acre; each produces one fruit at the end of two years.

The candied peels of three members of the genus *Citrus* (family *Rutaceae)* contribute their acid-sweet flavor to the fruitcakes. They are the sour ORANGE *(C. aurantium)*, the LEMON *(C. limon)*, and CITRON *(C. medica)*. Of the three the orange is the most hardy, the citron the least. The orange and lemon are grown in America's Citrus Belt, but commercial production of the lemon is concentrated in

California where growing conditions are ideal. Citron is grown commercially in the sub-tropical Mediterranean countries and in Puerto Rico. All are fruits of the small to medium-sized evergreen citrus trees native to tropical and subtropical Asia. Propagation is by seed and by shield-budding of wanted varieties on seedling stock of the same or other species such as the sour orange, the rough lemon, and the trifoliate orange. Linnaeus considered the lemon a variety of *C. medica;* some authorities think it may be a hybrid of citron crossed with lime. The Crusaders brought it to Europe from Palestine; it came to the New World from Spain. The orange traveled with Arab traders from Asia to Africa to Spain; the Spaniards brought it to Florida probably about 1565.

Citrus fruits can be grown in a variety of soils but one that is deep, mellow, and rather open is best; good drainage is imperative. Cover crops to provide the humus essential to the trees is established orchard practice. Fertilizer to supply nitrogen, phosphorous and potash is applied as needed; trace elements have shown good results. The degree of cold is the decisive factor in determining where the fruits can be grown.

Due to growing seasons Florida oranges are marketed from October to July; California oranges the year round. Oranges are harvested when ripe; lemons when gree, after the fruit has reached a diameter of 2-1/4 inches (fruit which passes through a ring that size is left to grow larger). The sour orange not only provides seedlings for grafting stock but also fruit for the making of orangeade, marmalade and the bulk of the candied peel used commercially. The tree is hardy and disease resistant. The forms most generally found in the U.S. are Bittersweet, Paraguay and Bergamot. Most of the domestic sour oranges are grown in Arizona, Florida and California. The leading lemon varieties are Eureka and Lisbon. By-products of citrus are produced as close to the growing areas as possible because it is less expensive to ship them than the fruits. The varieties of the sweet orange *(C. sinensis)* whose peels are especially good for candying are the Brazilian Bahia or Washington navel and the Spanish Valencia.

Italian and Corsican immigrants brought citron seed to Puerto Rico; grafted trees were later introduced by the U.S. Department of Agriculture. Today citron is grown on more than 500 small farms,

representing about 9% of the island's farm acreage, three-quarters of it in the central Adjuntas municipality. Three varieties are important: Earle, Diamante, and the sweet Corsican. Citron is best for use when still slightly green in color but fully mature. The fruit, with its thick, rough peel, is processed to produce citron brine *(salmuera)* and candies, most of which are exported to the U.S.

The BOURBON whiskey which is used both to help flavor and to cure the black fruitcake is made from yellow Dent Corn *(Zea mays* var. *indurata)*, a hybrid type. It is a descendant of the annual maize or Indian corn *(Gramineae* family) long believed native to the Americas but now described as of "undetermined origin." The Federal Alcohol Administration defines bourbon as whiskey which has been distilled at not exceeding 160 proot from a fermented mash of not less than 51% corn grain, and which has been stored for at least two years in charred new white oak containers.

Whiskey supplanted rum as the preferred American drink when, in the late 18th century, the settlers, especially those of Scotch and Irish origin, discovered that the Indian corn equalled rye *(Secale cereale)* and barley *(Hordeum vulgare)* for making strong spirits. The first bourbon was made in 1789. The yellow Dent, used by today's distillers of bourbon, comes from the Corn Belt states of Iowa, Illinois, Indiana, and Ohio. Only the best grains available are selected; distillers are particularly careful about harvesting, storage, and odor of the grain; a good bourbon requires corn that is smooth, wholesome, and nice smelling. The higher proportion of corn used, the lighter the body of the whiskey; the larger the proportion of small grains used—rye and barley—the heavier the body of the whiskey becomes. For example, whiskey made with a 65% mixture of corn has a lighter body than whiskey made with only a 55% mixture of corn, if distilled at the same proof.

During the weeks—or months—that the black fruitcake cures in its bourbon-saturated cloth, and the golden fruitcake in its brandy-doused wrapping, it is necessary from time to time to replenish the liquids to avoid having the cloths dry out. This is a pleasant task, affording an appropriate occasion to reflect that the making of a fruitcake is both a botanical adventure and a culinary celebration of the boundless beneficence of the plant world.

GOLDEN FRUITCAKE

1 c. butter
1 c. granulated "vanilla sugar"
or use plain sugar and 1 tsp. vanilla extract
5 eggs
2 c. sifted all-purpose flour
1 tsp. salt
1 tsp. ground mace
1-1/2 tsp. baking powder
1/4 c. sherry
3/4 lb. white raisins
1-1/2 c. blanched almonds, slivered
1/2 c. Brazil nuts, sliced
1-1/4 c. candied pineapple, diced
1-1/4 c. shredded coconut
1/4 lb. ea. candied red and green cherries, sliced
1/4 lb. ea. candied lemon and orange peel, chopped
1/4 lb. citron, finely cut
brandy to cure

Use 1/2 c. of the flour to dust fruits and nuts. Cream butter and sugar until light; add eggs one at a time, beating well after each addition. Sift flour with salt, baking powder and mace. Add to batter alternately with sherry. Add floured fruits and nuts. Stir until well mixed. Pour batter into one 10-in. tube pan, buttered and lined with buttered brown paper; or three loaf pans prepared same way. Bake at 275° for about 3-1/2—4 hrs. for larger cake; 2—2-1/2 hrs. for small cakes.

BLACK FRUITCAKE

1/2 lb. butter
1 c. granulated "vanilla sugar" or substitute as in golden cake
1 c. brown sugar, packed
5 eggs
1/2 tsp. salt
2 c. sifted all-purpose flour
1/2 tsp. baking powder
1/2 tsp. ea. cinnamon, cloves, nutmeg and allspice
1 tbsp. milk
1/4 lb. blanched almonds, slivered
1/4 lb. pecans, chopped
1 lb. golden raisins
1/2 lb. dark raisins
1/4 lb. currants
1 lb. candied pineapple, shredded
1/2 lb. candied red cherries, halved
1/8 lb. ea. candied orange and lemon peel, chopped
1/2 lb. citron, chopped
1/2 c. good bourbon

Mix fruits, add bourbon and let stand overnight. Combine fruits, nuts and 1/2 c. of the flour. Sift remaining flour with salt, baking powder and spices. Cream butter, adding "vanilla sugar" gradually. Add eggs, beat well. Add milk. Fold in flour mixture. Pour batter over fruits and mix well. Bake at 275° in one 10-in. tube pan or two 9 x 5 x 5 loaf pans which are greased, lined with wax paper and greased again. Bake tube pan about 4 hrs.; loaves about 2-1/2—3 hrs. Complete as with golden cake.

FOR BOTH CAKES: Have pan of water in bottom of oven while baking. *Decorate* with sliced fruits and nuts if desired by removing cake from oven about one hr. before it is done, arranging fruits, etc., on top, and returning to oven. *To cure*: when cool wrap cake in white cloth saturated with brandy (golden cake) or bourbon (black cake) and place in airtight container. Keep wrapping moist for 3-6 weeks (or longer) curing period before serving.

BARRO COLORADO ISLAND

The Forest

Tom Croat

A TROPICAL FOREST is a moist, exotic place with unusual sounds, large mammals, and poisonous snakes. Barro Colorado Island, where I am doing research for a revision of that island's flora, is such a place. The dangers and frustrations of collecting plants are many, but the reward of working with exciting flora is more than enough to compensate.

Barro Colorado, an island of approximately six square miles, was formed by the rising waters of Gatun Lake which makes up the bulk of the route of the Panama Canal. It is situated midway on the isthmus between the Atlantic and Pacific oceans, and rises to an elevation of 450 feet above the level of the lake. It was set aside in 1923 as a biological preserve. Since that time it has served as host to countless biologists doing tropical research. My work is being accomplished through the cooperation of the Missouri Botanical Garden and the Smithsonian Tropical Research Institution which operates the research station on the island.

I had been warned by fellow botanists that plant collecting here would not be an easy task. The many miles of trails go to all parts of the island through a wide variety of habitats. The island's rough

Examining the base of a large fig tree (Ficus). Author photo

terrain is deeply cut with fast moving streams. Erosion has exposed tree roots in the trails and during the rainy season the trails are slick and hazardous.

The island is densely covered with large trees, many of which reach well over one hundred feet in height, and others which form several thick understory layers. Special methods are needed to collect higher specimens. A clipper pole is good for collecting plants within reach but is too difficult to carry through the forest. A length of rope with a lead weight on one end can often be tossed like a bola at the desired specimen to pull it to the ground.

Whenever an interesting flower, flower part, or fruit is found on the ground, climbing irons can be used to scale the trees in search of the parent tree. It is usually possible to return to the ground with a number of other interesting specimens found along the way.

As often as not you find yourself in the wrong tree, but may be able to transfer to the proper tree if its branches grow close together. The weighted rope may also be used to obtain specimens from another tree without having to shinny down the one tree and up the other.

Climbing is generally dangerous and strenuous work even with good climbing equipment. The gaffs must be razor sharp to insure deep penetration into the tree but can just as easily penetrate thick leather or a leg (as a scar on the calf of my leg can testify!). Even with a safety belt, a person may be only one slip from death or serious injury.

A tree with a very narrow trunk does not provide enough lateral stability so that being slightly off balance may cause you to spin helplessly around the tree. On the other hand a tree with a diameter greater than three feet is difficult, especially if laden with vines. It's almost impossible to swing the safety rope higher on such a trunk while climbing. To climb these difficult trees, you can either remove the vines and other obstructions or remove the safety belt and squirm through the vines. If cut vines happen to be members of the *Apocynaceae* with milky sap, it's a messy business. The dried sap, like pine pitch, attracts dirt, is not affected by soap and water, and must be scraped off. Clearing these vines away with a machete while fastened to the trees can be dangerous. Once I nearly "unfastened" myself by almost severing my own safety rope!

Trees with very hard wood are dangerous to climb as gaffs will

Author photo

Inspecting epiphytes for flowers. Unusual plants, even though they are sterile, are carried back from the field, provided they are epiphytes and can survive such a change. In due time, they usually flower in the laboratory's epiphyte house. Then herbarium specimens can be made of the plants.

not at first bite deeply enough. Attempts to stamp one climbing spur into the hard wood often cause the other foot to work loose and there you are standing in mid-air!

Climbing a tree of large diameter is much like scaling a wall. It is impossible to use a safety rope, but there are usually large woody vines on such trees which can be used as hand holds while climbing. In one such case I climbed more than eighty feet before the tree bole was small enough to use my safety belt.

It is easy to develop a false sense of security in the canopy since the ground is no longer visible and the tops of understory trees are only a few feet below. Despite the hard work, the climb is almost always worth the effort. Being in the canopy or above it is like being in another world. I am always inclined to linger and gaze across the rolling sea of green at the beautiful blue waters of Gatun Lake, always in sight from the taller trees. One can see nearly half of Barro Colorado Island from some spots. On a clear day it is possible to see

the shipping channel of the Panama Canal almost as far as the Gatun Locks on the Caribbean!

Besides the aesthetic rewards of such scenery and the thrill of climbing, collecting is usually equally rewarding. The broad flattened branches of some trees are so laden with epiphytes as to appear like a small elfin forest. I once spent the entire morning in one large tree and returned to the ground carrying several bags full of plants. In addition to the many small species of epiphytes this same tree hosted an epiphytic tree. Found growing 100 feet high on the host this epiphyte was more than thirty feet tall and had a trunk nearly one foot in diameter! Except for occasional tree-falls, collecting in this manner is the only way many species will be found.

Barro Colorado also has an exceedingly rich fauna. With one exception when I was attacked by a half tame collared peccary (wild pig), I have had no serious encounters with animals. The animal life in the canopy is as interesting as the plants. One day after hearing muffled grunts behind me, I was startled to see four curious howler monkeys quietly fidgeting on a branch only a dozen feet away. They were apparently surprised to see *Homo sapiens* invading their realm! Having heard the tremendous noise these beasts can make I was surprized at how quiet they could be. It was not until I began to cut off a small limb that they began their shattering chorus.

There were red spider monkeys and white-faced *Cebus* monkeys in the trees. The latter usually looked on from afar and would show their displeasure by throwing branches. Red spider monkeys were more apt to come within a few feet, hang by their tails and scowl.

I frequently saw large iguanas in the tree tops which would jump to the ground when they saw me. I always wondered as they went thundering down through all the branches if I could survive such a fall as well as they do!

Once while carefully climbing a tree I bumped into a sleeping sloth. The beast fairly flew the first five feet then lapsed into its usual pace as it slowly climbed a vine into another tree to find an undisturbed place to sleep.

Insects are an aggravation to the plant collector. In the dry season ticks abound and evenings are spent in their removal. In the wet season there are mosquitos, deer flies, and, of course, the ever present chiggers. Worst of all are the ants. It's almost impossible to collect a plant or climb a tree without having ants crawl on you.

Usually these are small biting ants which are only a problem in large numbers. Stinging ants are the real menace.

While climbing a large tree I once stumbled over a large ant nest only to be faced with a dozen more nests in the crown of the tree. As I was stubbornly chopping away at a branch to get some specimens, the ants covered the exposed parts of my body. On fire from their stings, my descent to the ground was considerably quicker than the climb!

These small stinging ants are mild compared to the large *paraponera* ants which are an inch long and have a sting so fierce that some people have reportedly required bed rest following an encounter with them. Fortunately these ants are usually found foraging in trees in smaller numbers.

While collecting out on a limb one day a large group of *paraponera* ants came down the trunk. When I returned to the base of the branch I found my path blocked. While the ants stood ready with their large pincers flexing, I retreated and lowered myself fifteen feet to the ground with my length of rope.

Though seemingly inanimate, the plant kingdom deserves credit for its ability to harass those who would venture through the forest. There are many species of armed vines which seem to jump out to gouge, snag, or cut the invading explorer. The worst of these is a vine-like sedge I have learned to carefully avoid. This plant has tiny recurved hooks on the three sides of its long stem which cut like a razor. The plant, having caught you, tends to fall upon you in a dense mass. All but the slowest, most calculated movements produce painful cuts. Sudden movements cut through clothing and deeply into the flesh.

It is a welcome change to return to the air-conditioned laboratory after a morning in the forest. Few places in the tropics afford the luxury of being able to collect in a rich forest so close to comfortable working and living quarters.

COLLECTING WATERLILY STAMPS

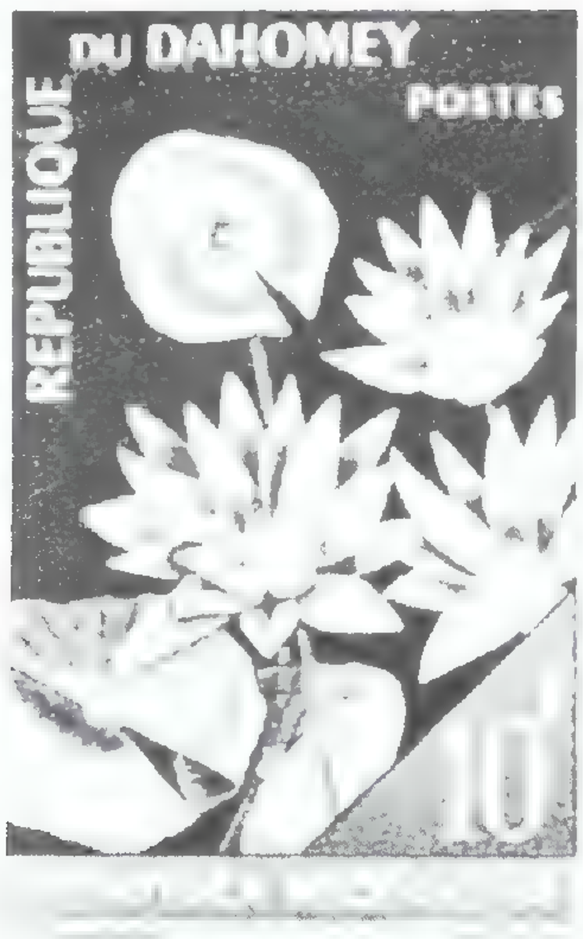
R. S. Trickett

R. S. Trickett, an amateur botanist, is an Honorary Fellow of the Linnean Society of London. He collaborated with George Pring for over 25 years, helping to find seeds and introduce new lilies. Mr. Pring considers Trickett to be England's expert on tropical waterlilies.

HAVING SPENT a number of years in the study of plant life, I have been interested to see the many beautifully reproduced flowers on postage stamps. Much of my time has been devoted to the study of aquatic plants, particularly the waterlily *Nymphaeaceae*, a family of eight genera. Although only a novice in philately, I have in recent months acquired a number of stamps illustrating three of these genera, *Nymphaea, Victoria,* and *Nelumbo*. Doubtless many more stamps have been issued, but I have been unable to trace them in the standard catalogues.

I should have started my collection in 1950 while corresponding with a Finnish friend with whom I exchanged seeds and tubers of waterlilies. When writing to me my friend always used the stamp issued that year which depicts their native white waterlily, *Nymphaea candida*.

Unless I am mistaken the first country to issue a stamp portraying nymphaeas was El Salvador, Central America, in 1938. This charming pictorial stamp shows a native girl at a waterlily pool filling a narrow-necked jar with water. In 1964 another stamp was issued by El Salvador of a waterlily which one assumes is the native *Nymphaea ampla*. The illustration, based on a drawing, erroneously shows the stamens protruding above the petals, but as the stamp is most attractive one should perhaps allow some artistic license. To obtain this stamp I had to purchase an expensive set. Later, when checking the species of this waterlily with a botanist friend in El



Claude Johnston

The colors and design of many of these stamps make them true works of art. The Macao stamp, perhaps the handsomest of all, shows the delicately shaded white flower standing in rich contrast to an intense blue background. The sacred lotus of the Buddhists, *Nelumbo nucifera*, graces this handsome stamp from Macao (1955), the Portuguese island colony near China. (left)

The huge-leaved *Victoria amazonica* is featured on this stamp issued by Hungary in 1965. Shown here is the deep pink second night flower. (center)

This stamp issued in 1967 by the Republic of Dahomey, formerly French West Agrica, shows the *Nymphaea micrantha*, of particular botanical interest because it is viviparous. The rudimentary form of the tuber from which the new plant arises is shown here on each leaf. (right)

Salvador, I received his reply in an envelope with ten of these stamps on the address side and another ten on the back, uncanceled.

Apart from the above mentioned stamps my small collection contains the following items listed by genera and then in chronological order as follows:

In 1952 a stamp of *Nymphaea lotus* was issued by the Belgian Congo, and in 1957 Germany issued a waterlily stamp, unnamed, but resembling the white waterlily *Nymphaea alba*. For "Lotus Flower Week" in 1958 Ceylon released a stamp showing a girl gazing at a flower of *Michelia champaca (Magnoliaceae)* held in her right hand while holding waterlilies in her left hand. The illustration is copied from the fresco on the Sigiri Rock dating from the fifth century. A stamp from Holland in 1960 shows three flowers of *Nymphaea alba,* and a fine one from Poland in 1962 illustrates this species with flower, leaf, and bud. A Turkish stamp issued the same year bears a flower the catalogues describe as *Nymphaea alba;* however, it somewhat resembles *Nelumbo nucifera* and the flower is pink!

In 1963 Bulgaria gave us a stamp of *Nymphaea alba,* and the same year two flowers of *Nymphaea lotus* appeared on a stamp from Upper Volta. Mauritania also featured this species in 1964, and the same year Switzerland used *Nymphaea alba* in one of the *Pro Juventute* set. In 1965 Rumania, Albania, and the Republic of Somalia each issued a stamp portraying a waterlily. The Rumanian stamp has a very nice picture of *Nymphaea zanzibariensis* described by Dr. Henry S. Conard, author of the magnificent monograph *The Waterlilies,* as "The King of all the waterlily tribe." The flowers of this sweetly scented waterlily, often ten inches across, have two color phases, one with blue flowers and the other rose pink tinged with purple.

The Albanian stamp of *Nymphaea alba* is unique in my collection, a white flower on a glossy green background. The stamp from the Republic of Somalia, printed in Italy and captioned "Fiori d' Africa," shows a flower with broad red petals. It closely resembles one of the hardy waterlily varieties but is not a native species as the caption implies. In a letter received from the Somali Embassy in London, I was informed the color should have been white. Unfortunately the designer of the stamp has since died, so no further information is available. Two species of waterlily are indigenous to Somalia: *Nymphaea lotus,* which is white and nocturnal; and *Nymphaea cae-*

rulea, blue and diurnal. A white variety of the latter species, *Nymphaea caerulea* var. *albiflora*, may be the waterlily on another Somali stamp of 1968 associated with a white stork standing in the water.

In 1966 the Republic of Guinea issued a set of stamps showing native women's headdresses and flowers, and two values featured waterlilies. In 1967 Cook Islands in the Pacific Ocean released a stamp of a blue waterlily titled "Walter Lily." This issue was short-lived, the correct spelling appearing on another stamp shortly afterward. A stamp issued that same year by Guatemala shows some blue-flowered waterlilies in an artistic arrangement of cut flowers captioned "Ninfas de Amatitlan." As no blue-flowered species is native to Guatemala, it probably represents the imported species *Nymphaea zanzibariensis* which, according to Standley and Steyermark in their *Flora of Guatemala*, is occasionally grown ornamentally in Central Park, Guatemala City. It also has become very much a feature of Lake Amatitlan.

Another 1967 stamp, from Dahomey, is of particular botanical interest. It features *Nymphaea micrantha*, a tropical waterlily which is viviparous. A tiny new plant, with miniature leaves and flowers,

Claude Johnston

Nymphaea alba, described as "the finest of English flowers" by a former director of the British Museum, is depicted on this stamp issued by Poland in 1962. (left)

Nymphaea alba, probably the best known and best loved of all the waterlilies is seen again on this stamp issued in 1965 by Albania. (right)

arises on the parent plant from a tuber that forms on the upper side of a leaf above the insertion of the leaf stalk.

In 1968 an Egyptian stamp pictured a highly stylized version of the lotus. There are two species of this waterlily, *Nymphaea lotus* and the sweetly scented *Nymphaea caerulea*. Both played an important part in the lives of ancient Egyptians and were figured on monuments and tombs as early as 3500 B. C. At convivial meetings a blue lotus flower was presented to each guest.

Apparently the first member of the waterlily family ever to be represented on stamps is *Victoria amazonica*. British Guiana (Guyana) has issued three stamps illustrating this plant. The first, in 1934, bears a portrait of King George V and shows Victorias growing in Georgetown Botanical Gardens. The second, in 1945, shows a flower and leaves and a portrait of King George VI, while the third, in 1954, is similar but pictures Her Majesty, the Queen. The name "Victoria Regia Lilies" used on each stamp has since been changed to *Victoria amazonica* to comply with the International Code of Botanical Nomenclature. The flowers of this giant waterlily measure from twelve to fourteen inches across and are nocturnal, being white the first night of opening and later turning a deep pink. The leaves are often more than six feet across, and will support evenly distributed weight of well over 100 pounds.

Victoria amazonica is native to Guyana and the Amazon in Brazil but is a favorite of European botanic gardens where its huge leaves always attract attention. On a 1940 Brazilian stamp showing this flower, the leaf occupies nearly the entire area, as if to emphasize its enormous size. In 1965 the white first night flower appears on a Rumanian stamp and the deep pink second night flower on one from Hungary. Both are labeled *Victoria amazonica*. The following year the U.S.S.R. portrayed the related species *Victoria cruziana*, showing both first and second night flowers. The pronounced veining on the higher upturned margin of the leaves of this species is clearly visible.

The remaining member of the waterlily family to be featured on my stamps is *Nelumbo nucifera*, the sacred lotus of the Buddhists. In 1955 Macao issued a stamp with a white flower described as "Flor de Lotus," which one assumes is a flower of *Nelumbo*.

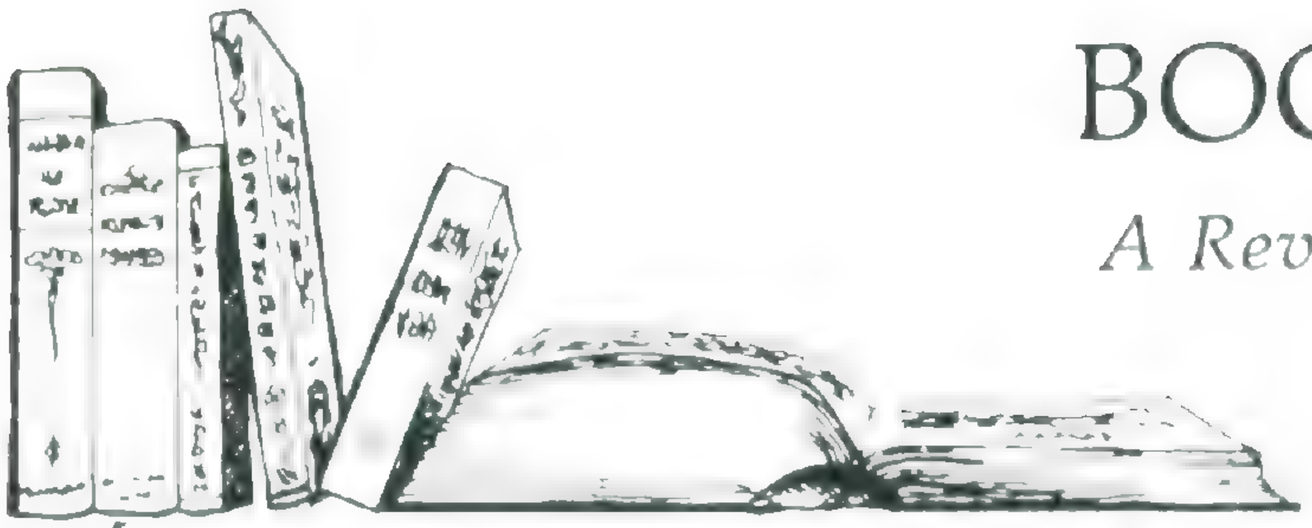
There are also pink and red forms of this lovely flower which stands three to four feet out of the water. Commemorating United

Nations Day in 1954, an Indian stamp features a stylized version of a flower resembling *Nelumbo nucifera*. A small stamp issued by the Republic of China in 1955 has a stylized *Nelumbo* printed in green-blue ink on a white base. The following year the Republic of Indonesia issued a stamp similar in design to India's. In 1962 North Vietnam labeled their colorful stamp of *Nelumbo "Nelumbium nuciferum,"* which is incorrect according to the International Code of Botanical Nomenclature, the name *Nelumbo* (1763) having priority of publication over *Nelumbium* (1789). In 1965 South Vietnam released a stamp featuring this plant, and the following year the U.S.S.R. also included a very nice illustration of *Nelumbo* in the same set as the *Victoria* stamp mentioned above.

Waterlilies are to be found in rivers and streams all around the world, but many very attractive species have yet to make their appearance on postage stamps. India has several lovely ones; prominent among them is *Nymphaea rubra*, a very fine nocturnal waterlily with deep purplish-red flowers often ten inches in diameter. In Australia grow the largest of waterlilies, *Nymphaea gigantea*, whose twelve-inch flowers of soft azure blue have centers filled with bright yellow stamens; there are also white and pink forms of this lovely species. One of the loveliest and least known of all, *Nymphaea stuhlmannii*, exquisitely daffodil scented, with bright yellow flowers and golden yellow stamens, grows in Tanzania.

Sir Ray Lankester, a former Director of the British Museum (Natural History), in his book *Science From An Easy Chair* described our native waterlily *Nymphaea alba* as "the finest of English flowers." Although a number of British plants have been featured on stamps issued by Great Britain in recent years, this waterlily is not among them. A stamp marking the Xth International Botanical Congress depicts a plant the stamp catalogues describe as a "fringed waterlily." This plant is not a waterlily, but is *Nymphoides peltata*, of the family *Menyanthaceae*.

There are several species of waterlilies that are native to the United States. One may hope that countries which have not issued stamps illustrating waterlilies will, when considering flower stamps for future issues, include these beautiful flowers, many of exquisite scent and colors not equalled in variety or brilliance by any other plant.



BOOK CORNER

A Review by Edgar Anderson

DARWIN AND HENSLOW.
THE GROWTH OF AN IDEA

Letters 1831-1860
Edited by Nora Barlow
(University of California Press)

THE GROWTH OF AN IDEA contains 104 letters from Darwin to Henslow and 7 from Henslow to Darwin. Six additional letters from other members of the two families round out the story of the productive association between Charles Darwin, the eminent scientist, and the Rev. J. A. Henslow, Darwin's Cambridge Professor and life-long friend. (The portrait of Henslow on page 149 shows a handsome man radiating intelligence and kindliness).

Darwin's earliest memories of Henslow are reprinted in Appendix I. The following account is somewhat condensed:

"Before coming up to Cambridge I had heard of him from my brother as a man who knew every branch of science. Before long I became well acquainted with Henslow and took long walks with him on most days; so that I was called by some of the dons 'the man who walks with Henslow.' His knowledge was great in botany, entomology, chemistry, mineralogy, and geology. His judgment was excellent, and his whole mind well balanced; but I do not suppose that anyone would say he possessed much original genius. He was free from every tinge of vanity or other petty feelings; and I never saw a man who thought so little about himself. I cannot resist mentioning a trifling incident which showed his kind consideration.

Whilst examining some pollen grains on a damp surface, I saw the tubes exserted, and instantly rushed off to communicate my surprising discovery to him. Now I do not suppose any other professor of botany could have helped laughing at my coming in such a hurry, to make such a communication. But he agreed how interesting the phenomenon was and explained its meaning but made me clearly understand how well it was known; so I left him not in the least mortified, but well pleased at having discovered for myself so remarkable a fact, but determined not to be in such a hurry again to communicate my discoveries."

The letters exchanged between these two men serve as a pleasant introduction to the life of an able, prosperous scientist in Victorian England. Darwin and his large family settled down comfortably in Down House, his home in rolling hills just outside London, where he did virtually all of his writings and also carried on experiments and observations with plants and animals. It was here that he toiled for thirty-one years getting many kinds of evidence for his new theory of evolution before publishing it in 1859: *"On the Origin of Species by Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life."*

Though theories of evolution go back to the ancient Greeks, it was not until Darwin published his book that most scientists accepted the theory. His facts were so effectively put together that it convinced most educated people of the reality of evolution. It was influential not only in biology but in philosophy, the social sciences, and political economy. It made him one of the great men of his century. The central idea of the new theory of evolution came to him in the Galapagos Islands, when as a young man just out of the University, he served as official naturalist for Her Majesty's Ship, "Beagle," on its five-year voyage of exploration. He would never have been chosen to make the trip had it not been for the insight and persistence of Henslow.

It is interesting to note Henslow's reaction to Darwin's *Origin of Species,* which in a sense he made possible. His strict education in the Church of England made it difficult for him to accept this radical theory and so along with other theologians of the time, he strongly disapproved of the book. But Henslow's disapproval of the *Origin of Species* did not dampen his enthusiasm for the *Voyage of the Beagle,* a charming little book (and a great literary success) describ-

ing the five-year voyage of exploration—the delays; the crowded quarters; the majestic, complex vegetation of the tropics; the manner of life in many odd corners of the world. And so, despite the disagreement over "The Origin," the friendship between the two men continued unabated.

Of particular interest to botanists are those letters in *The Growth of an Idea* dealing with Darwin's experimental studies of plant domestication, weeds, and variation, which eventually developed into a whole series of books in the general field of plant physiology.

Darwin was eminent in so many ways that we usually forget that he was also one of the greatest plant physiologists of the 19th Century. Among other things, he originated the techniques that made possible the rapid development of plant hormones in the 1930's. The letters concerning these experiments have a special charm, for he enlisted the enthusiastic help of Henslow's granddaughters. In 1885 there were successive requests. On July 4th Darwin sent a list of 77 species needed for one experiment and wrote: "Will you employ your little girls to collect these?" On July 28th he wanted seed of wild celery for another experiment: "I want to ascertain whether wild or tame plants of the same species produce most seed." On August 23rd he wrote again: "I am very anxious to compare numbers of seed in wild and cultivated plants. I want precise facts. So will you get one of your little girls to get the finest half-wild celery near you, and either count all the seeds or count all the umbels and count seeds in an average umbel?" On November 10th Darwin wrote: "I am *very much* obliged for the seeds, especially for the experimental seeds. I sent a postal order for ten shillings for your good little botanists, and I am sure the girl who counted the parsnip seeds deserves a perfect dowry."

Darwin lived out his years in Down House. After his death, the house and land were purchased and given to the nation. Though it is now in outer London, contours of nearby hills conceal the masses of suburban residences. Scientists familiar with Darwin's life and work there, report that going through the peaceful old house made them feel as if they had been there in Darwin's day. They advise an excursion to Down House as the quickest, cheapest, and most rewarding way for visiting Americans to catch a glimpse of rural England.

MISSOURI BOTANICAL GARDEN BULLETIN
A SELECTIVE INDEX FOR VOLUME LVII (1969)

NOTE: This is a selective index and therefore there are omissions of certain regular features of the *Bulletin* such as "From the Director," Friends of the Garden, various news articles and rosters, "Who, What, Where, When," etc.

The index is in three parts: Title, Author, and Book Reviews.

*indicates that an article is illustrated in some fashion.

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The Missouri Botanical Garden Arboretum—1600 acres—established at Gray Summit, Missouri, in 1926, is open to the public.

The Garden—70 acres—is open every day except Christmas and New Year's. For the main entrance, grounds, Climatron, display greenhouses, and Floral Display House:

May 1 through October 31 . . . . 9:00 a.m. to 6:00 p.m.
November 1 through April 30 9:00 a.m. to 5:00 p.m.
Sundays and Holidays . . . . . 9:00 a.m. to 7:00 p.m.

For Tower Grove House:

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November 1 through April 30 10:00 a.m. to 4:00 p.m.

The Display House presents four major shows: November, Chrysanthemums; December, Poinsettias; February, Orchids; April, Spring Flower Show. During the year other shows, competitions, and festivals are sponsored by various garden clubs and flower societies.

Courses in botany and horticulture for adults are conducted by the Garden staff. Children's nature classes are provided free on Saturdays from mid-September to early June. The Pitzman Nature Program is held for children during the summer. The Garden is world famous for its scientific research program. The scientists of the Garden hold teaching appointments on the staff of Washington University.

The Missouri Botanical Garden was established for the public's benefit in 1859 by Henry Shaw. The Garden, a non-profit institution, relies for support solely upon contributions from the public, the Arts and Education Council, and income from the Shaw estate. The Garden receives no city or state tax support.

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